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UNITED STATES DEPARTMENT OF AGRICULTURE

BULLETIN No. 393

Contribution from Office of Public Roads and Rural Engineering
LOGAN WALLER PAGE, Director

Washington, D. C. ▼ October 23, 1916

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ECONOMIC SURVEYS OF COUNTY HIGHWAY IMPROVEMENT

A COMPILATION AND ANALYSIS OF DATA IN EIGHT SELECTED COUNTIES, SHOWING COMPARATIVE FINANCIAL BURDENS AND ECONOMIC BENEFITS RESULTING FROM HIGHWAY IMPROVEMENT DURING A PERIOD OF YEARS

By

J. E. PENNYBACKER, Chief of Road Economics, and
M. O. ELDRIDGE, Assistant in Road Economics

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ECONOMIC SURVEYS OF COUNTY HIGHWAY IMPROVEMENT.

A Compilation and Analysis of Data in Eight Selected Counties, Showing Comparative Financial Burdens and Economic Benefits Resulting from Highway Improvement During a Period of Years.

By J. E. PENNYBACKER, *Chief of Road Economics*, and M. O. ELDRIDGE, *Assistant in Road Economics.*

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INTRODUCTION.

In order to obtain direct information as to the benefits and burdens imposed upon communities through the construction of systems of improved roads, it was decided in 1909 by the Office of Public Roads to make a series of exhaustive studies in selected counties. These studies were designed to cover a period of approximately 5 years, or a sufficient period to show the road improvement from its inception until such time as the full measure of its usefulness could be demonstrated. The counties selected were Spotsylvania, Dinwiddie, Lee, and Wise in Virginia, Franklin in New York, Dallas in Alabama, Lauderdale in Mississippi, and Manatee in Florida, as in those counties bonds had been recently voted for the construction of improved roads and it therefore was possible to make a series of studies to cover the road improvement from the outset to completion.

The information which has been assembled during the years 1910 to 1915, inclusive, comprises general descriptions of the character

and resources of the counties studied; the character, extent, and cost of the road improvement; the effect of the improvement on assessed valuation of property; the financial burden as indicated by tax rates; and the general prosperity and welfare of the respective counties as shown by output of local products, the character and amount of traffic, the saving in hauling costs, the incoming and outgoing shipments of freight by rail and water, the values of lands contiguous to the roads improved, the attendance at public schools, the character of school buildings, the number and distribution of population, and other related information. These studies were made at one-year intervals and, as nearly as possible, exactly comparable information was obtained on each inspection. To reenforce these records a number of representative points were selected and photographs taken each year of these same locations, thus securing a pictorial record of the changes evolved from year to year.

COMPARATIVE ANALYSIS OF THE ECONOMIC EFFECTS OF ROAD IMPROVEMENT.

Many claims and counterclaims are made as to the propriety of expending large sums of money for public-road construction in local communities. One set of extremists ascribe to good roads nearly all the benefits and blessings which fall to the lot of humanity, while another set sees in large outlays for road construction only the specter of debt and ruinous taxation. Somewhere between these two extremes must be placed the actual result produced.

The economic studies in the eight selected counties have brought out a number of features which can not fail to prove helpful examples to other counties which contemplate large outlays for road construction. A comparative analysis of the most striking data obtained in the respective studies is therefore presented under appropriate headings.

CHARACTER OF BONDS ISSUED.

In some of the counties comprised in the economic studies bonds were issued on the sinking-fund plan, and in others the serial method was followed. Analysis of the methods followed in each case brings out some interesting points. Spottsylvania County, Va., issued $173,000 of 4.5 and 5 per cent bonds payable in 30 years, and callable after 5 years. It is impossible to estimate the total cost of retirement owing to the element of variability in the rate of retirement under this arrangement. In Dallas County, Ala., the bonds amounted to $350,000, payable in 30 years at 5 per cent. Assuming the sinking fund to bear 3 per cent interest, as set forth in the chapter on Dallas County, the total financial burden to the county for interest and the liquidation of the bonds during the 30-year period will be

$745,702. That the method of financing the road improvement chosen by Dallas County is not as economical as might have been selected is indicated by the fact that an equal amount of bonds at the same rate of interest, if issued under the deferred serial bond method, with the first bonds payable 6 years from the date of issuance and an equal amount payable each year thereafter for 24 years, would cost the county at the end of the 30 years $665,000, or a difference, as compared with the sinking-fund method, of $80,702. If 4 per cent could be realized on the sinking fund instead of 3 per cent, the saving for the deferred serial plan over the sinking-fund plan would still be $47,216.

In the case of Manatee County, Fla., the bond issues aggregate $250,000 and run 30 years at 5 per cent. As in this case the sinking fund also yields 5 per cent interest, the method of bonding is reasonably economical on the present basis. It is doubtful, however, if the sinking fund will continue to bring such an unusual return, and as soon as a lesser rate of interest is obtained or any of the sinking fund is not promptly invested, the sinking-fund method will become more costly than the serial method which might have been adopted.

Lee County, Va., adopted the deferred serial method, and had its bonds run from the fifth year to the twenty-sixth year. This is the only one among the entire eight which appears to have adopted the most prudent and economical method of handling the bond issue.

In Wise County the $960,000 of 5 per cent bonds were issued for 30 years, with a 20-year redemption clause. Assuming that the bonds are retired the twenty-fifth year on the sinking-fund plan, with interest on sinking fund bearing 3 per cent, the total outlay would be $1,858,269. If Wise County had adopted the serial method with its serial payments beginning with the sixth year and ending the twenty-fifth year, the total cost would be $1,704,000, a saving for the serial plan over the sinking-fund plan of $154, 269. If 4 per cent could be realized on the sinking fund, the saving would still be $72,288.

Dinwiddie County, Va., issued $105,000 of 5 and 6 per cent bonds, payable in 30 years, but the bonds are callable after 20 years. Assuming that they will be retired at the end of 25 years on the sinking-fund plan, with interest on sinking fund at 4 per cent, the total cost would be $218,031, whereas if they had adopted the 6–25 year serial method the cost would be $201,100, or a difference of $16,931.

Franklin County, N. Y., is operating at a disadvantage, as its first serial payment is not made until the tenth year. This county also has followed the rather dangerous method of extending its date of payment over a long period of years, with the result that the indebtedness long outlives the estimated life of the improvements

made. The bonds, amounting to $500,000 at 5 per cent, run from 10 to 50 years under the deferred serial method.

Lauderdale County, Miss., which issued $500,000 of 5 and 5½ per cent bonds, adopted the deferred serial-bond method, with the first payment coming 11 years from the date of issue and the last payment 25 years. If the county had issued the bonds on the 6–25 year basis the cost would have been $906,875, as compared with the cost on the basis adopted of $972,232, or a difference of $65,367.

It would seem that the most economical form of bond to issue is the deferred serial with the first payment at the end of the sixth year and the payments then extending to a final term varying in length according to local conditions, but never exceeding 30 years. By having the first payment deferred to the sixth year the county has an opportunity to complete its road system and enjoy the benefits before beginning payment, but if the deferred period is much greater all of the evils of the sinking-fund plan with no corresponding merits are adopted. If local communities throughout the United States could profit by these examples the result would be the saving of many millions of dollars.

In one of the counties it was found that an amount probably aggregating as much as $5,000 had been lost to the county through a premature sale of the bonds; that is, in selling the bonds before the funds actually were needed. This resulted in the payment of interest much in excess of that which could be obtained upon cash balances in bank. Counties should pay due regard to this feature of road finance, even though the necessary precautions would save only a small amount.

MANAGEMENT OF THE IMPROVEMENTS.

In the eight counties selected several forms of management were in effect and a noticeable tendency was demonstrated on the part of county authorities to select and designate for improvement a larger mileage of roads than the funds contemplated were adequate to construct. This was especially true in those counties where a considerable amount of grading was involved and where comparatively expensive types of construction were contemplated. Naturally these faulty estimates resulted in dissatisfaction and distrust among the taxpayers and to require either additional heavy outlays or the leaving of the project in a partially completed state. Judging from these examples, it is quite obviously essential that where any county contemplates comprehensive improvements involving large outlays and expensive types of construction, the detailed advice and estimate of a competent highway engineer be secured before the people are asked to approve the bond issue. In the case of the four Virginia counties the actual work of constructing the roads after the bonds

were voted was under the control of the State highway department, and it appears that excellent results were obtained commensurate with the outlay of funds; but the Virginia law was evidently defective in that no provision was made for a competent authority to make estimates and to give advice preliminary to the issuance of bonds. The Virginia Legislature has since, at its 1916 session, enacted legislation covering this point. The experience of the counties covered by these studies indicates the wisdom of a statute in each State requiring a reliable estimate upon which bond elections should be based.

The road construction in these counties would seem to bear out the assertion which has often been made that from 20 to 25 per cent of the total road mileage of a county, if wisely distributed, will serve traffic needs to the extent of at least 80 or 85 per cent of the total. In one of the counties included in these studies it will be noted that the mileage is excessively large in comparison with the ton-mileage hauled over the improved roads. In this case it would seem that the county has overbuilt its improved-road system and that a lesser mileage would have served its traffic needs.

A question partly of management and partly of finance is involved in the experience of the eight counties in regard to road maintenance. It is a well-known fact that the general tendency throughout the United States is to neglect the maintenance of roads which have, in many cases, been built at great expense. In the study of these eight counties it was found that Franklin County, N. Y., and Lauderdale County, Miss., were most effectively meeting the problem of maintenance. In the case of Franklin County the State was directly concerned in the maintenance of the roads and had complete control over such work on some of the roads and an indirect control over other roads, thus applying to the task a skilled management, the details of which are explained in the chapter on Franklin County. In Lauderdale County, Miss., the work is conducted under an excellent provision of law which specifies that an amount of not less than 1 mill on the dollar shall be levied to provide a maintenance fund for all of the roads constructed by means of bond issues, and this fund is to be kept separate from all other county funds and can be used only for maintenance. As a result of this law the Lauderdale County roads are not only in as good condition to-day as when completed, but have been actually improved. Thus the county's investment in good roads has not been allowed to deteriorate in the slightest degree.

The 1916 Virginia Legislature has met the maintenance situation by providing that an annual tax of not less than 3 per cent of the amount of bonds issued shall be levied to provide a maintenance fund. A conspicuous example of an emergency situation with reference to road maintenance is afforded by Spotsylvania County, where

no provision was made for maintenance of the bond-built roads. It was found that rapid deterioration was taking place and that insufficient funds existed with which to meet the situation. Accordingly toll gates were established on the principal roads and a sufficient revenue was derived from this source, not only to maintain the roads but to actually extend the construction a short distance. This reversion to a system long since abolished by most countries is partly due to the Virginia administrative and fiscal organization, under which the cities of the State are not taxed for county purposes (although they may aid in the improvement of roads for a distance of 10 miles from the city limits if the city council so elects). Thus it came about that while the city of Fredericksburg, in Spotsylvania County, contributed no part of the financial burden of maintaining the roads, it was, because of the heavy automobile traffic emanating from that point, a very destructive element to the county road system. In view of the very rapid development of motor vehicles during the past decade and the prospects of much more widespread use of this means of transportation in the future, the desirability of making provisions so that the cities may aid in the construction and maintenance of roads in the surrounding territory.

As to the quality of supervision, it would seem that there is little room for criticism in any of the eight counties. The work in the four Virginia counties was directed by a resident engineer from the State highway department, while the work in Dallas, Lauderdale, and Manatee Counties was all directed by special highway commissions, who, without exception, selected competent engineers and accomplished most commendable results. Franklin County, N. Y., was fortunate in having for the direction of its work a competent county superintendent, who possessed all of the practical and technical qualifications for the successful management of the work.

ECONOMIC BENEFITS TO THE RESPECTIVE COUNTIES.

In arriving at an estimate of the benefits which a county receives through the improvement of its public roads, certain factors must be taken into account more as the media by which the benefits may be measured than as the actual benefits themselves. While it is realized that the increase in the value of land must not be added to the saving in hauling costs, the convenience and access to schools, markets, churches, etc., but is rather the effect produced by those causes, it is perhaps the best index which can be obtained as to the economic value of the roads to the community. A study of the increase in the values of farm lands in the eight counties reveals the rather interesting fact that following the improvement of the main market roads the increase in the selling price of tillable farm lands served by the roads has amounted to from one

to three times the total cost of the improvements. The increase in values in those instances which were recorded ranged from 63 per cent to 80 per cent in Spotsylvania, from 68 to 194 in Dinwiddie, 70 to 80 in Lee, 25 to 100 in Wise, 9 to 114 in Franklin, 50 to 100 in Dallas, 25 to 50 in Lauderdale, and from 50 to 100 in Manatee. It will be found upon reading the chapters on the individual counties that the estimates of increase were based for the most part upon the territory within a distance of one mile on each side of the roads improved. These estimates are not claimed to be mathematically exact, but it is believed that they will give a fairly accurate indication of the results which may be expected under similar conditions.

In dealing with the effect of road improvement upon the hauling of commodities, the method has been adopted of ascertaining the traffic area served by each road much in the same manner as the drainage area of a stream is ascertained. After determining such areas the character and amount of production is ascertained and an estimate is made as to the proportion of the tonnage produced which is hauled upon the roads. A further investigation is made as to shipments by rail in and out of the county and information is obtained from United States census reports and from merchants and producers to verify the results obtained from the traffic-area calculation and the freight-tonnage inquiry. In some cases an actual traffic count or census is taken to determine the tonnage hauled upon the roads. From these various sources it is possible to arrive at a reasonably accurate estimate of the tonnage hauled over the improved roads. It is a comparatively easy matter to determine the average length of haul in each case and the prevailing rate of wages for men and teams. With these factors the total tonnage, the total ton-mileage, and the cost per ton-mile before and after the improvement of the roads are computed. The saving to traffic represented by the road improvement is thus expressed in dollars. It is of course realized that the figures given do not represent an actual "dollars and cents" saving, as many of the men and teams figured in on a wage basis might have been idle if they had not been engaged in hauling the products of farm and forest. But they at least indicate the saving in time and energy, and these have a monetary value. Therefore the saving to traffic in each county is stated for the purpose of indicating to the readers of this bulletin a relative figure by which they can determine the waste due to a system of poor roads. Considering the eight counties in the aggregate, the gross annual saving in hauling costs due to their good-roads systems affords the rather impressive total of $627,409 for a traffic of 3,489,652 ton-miles. The average gross saving per ton-mile for the eight counties is 17.8 cents, this being

indicated by an average rate of 33.5 cents before the roads were improved, as compared with 15.7 cents after the roads were improved.

In order to determine the net saving on a ton-mileage basis, it is necessary to deduct from the gross saving the estimated annual outlay for interest and retirement of the bonds and for interest on the value of aid received from the State or from any source other than the bond issue. Table 1 gives not only the gross saving per ton-mile, but also the net saving after taking into account the cost of the improvements on this basis. It should be borne in mind that the estimated annual outlay for interest and retirement of principal may not conform strictly to the practice which may be followed in the respective counties, as instead of levying the amount which would be mathematically correct for the purpose, they may raise an unnecessarily large amount or an utterly inadequate amount from year to year. The table is based upon the amounts they should levy each year to retire the bonds under the plan by which the bonds were issued. The annual cost of maintenance should be considered as a partial offset to the saving in hauling costs if the outlay for maintenance is greater after the roads are improved than before improvement. That the cost is greater after improvement can scarcely be doubted, as real maintenance was scarcely in effect at all before the roads were improved. Definite cost data on maintenance of a comparative value for all the counties are lacking, and are, therefore, not taken into account in the table.

TABLE 1.—*Approximate saving in hauling costs on present tonnage basis after deducting annual cost of improvements during period covered by bonds.*

[Averages are weighted.]

Selected counties.	Bonds issued.	Value of State-aid contributions in convict labor.	Estimated annual outlay for interest and retirement of principal.[1]	Annual ton-miles of traffic.	Annual cost of principal and interest and convict-labor aid per ton-mile of traffic.	Hauling cost per ton-mile.		Gross saving per ton-mile.	Saving per ton-mile after deducting cost of interest and principal.[1]
						Before improvement.	After improvement.		
Spotsylvania, Va..	[2]$140,000	$11,856.41	$10,533.00	921,521	$0.0114	$0.300	$0.137	$0.163	$0.149
Dinwiddie, Va.....	105,000	37,088.82	10,573.65	833,136	.0126	.300	.150	.150	.137
Lee, Va.....	455,000	21,175.48	27,997.34	247,180	.0941	.400	.200	.200	.106
Wise, Va.....	960,000	.....	74,330.00	200,000	.3716	.570	.230	.340	−.032
Franklin, N. Y....	500,000	.....	21,730.00	242,145	.0897	.303	.096	.207	.117
Dallas, Ala.....	350,000	.....	24,856.76	610,000	.0407	.300	.150	.150	.109
Lauderdale, Miss..	500,000	.....	33,466.66	255,378	.1310	.370	.200	.170	.039
Manatee, Fla.....	250,000	.....	16,262.85	130,292	.1247	.450	.200	.250	.125
Total and average.....	3,260,000	70,070.21	219,720.26	3,489,652	.0629	.335	.157	.179	.116

[1] Plus interest at 5 per cent on value of State-aid contributions of convict labor.
[2] Exclusive of $33,000 voted but not yet issued for Livingston and Berkley districts.

A comparison of the effect of the road improvement upon country schools affords probably a more complete vindication of the outlay than even the material features which have been presented. Combining the results obtained in all of the eight counties, it appears that before the roads were improved the average school attendance was 66 pupils of each 100 enrolled, as compared with 76 after the roads were improved. A consideration of this showing must reveal the fact that the good roads have been materially responsible for the education of 10 children out of each hundred. As the struggle for existence becomes keener in the years that are yet before us, the educational training which the children receive in the country schools will make itself felt more and more in the material and moral success of the man and woman. Not only have the roads contributed toward a larger school attendance, but they have been quite instrumental in lifting the standard of instruction by making easier the consolidation of little one-room schools into graded schools. In Dinwiddie County the system of taking the children to and from school by means of wagons has been adopted since the roads were improved. (See Pl. XI, fig. 2.)

Taking it from all of these angles, the experience of the eight counties has demonstrated that the beneficial effects of the road improvement justified the outlay, and that while more efficiency and economy might have been obtained in some cases, the loss was not such as to make the citizens of any of the counties feel that the move for better roads had been an unwise one. (See Tables 2 and 3.)

TABLE 2.—*Road mileage.*

State and county.	Total of all roads.	Miles of road per square mile of area.	Surfaced.		Graded under bond issue.	Total graded or surfaced.
			Under bond issue.	Total.		
Virginia:			*Miles.*	*Miles.*	*Miles.*	*Miles.*
Spotsylvania	400	0.97	[1] 76.73	82.73	0	82.73
Dinwiddie	524	1.01	[2] 91.3	101.06	0	101.06
Lee	450	1.00	[1] 39.26	44.86	[1] 60.19	105.05
Wise	300	.71	78.47	83.07	62.75	145.82
New York: Franklin	1,370	.82	124.0	386.8	0	368.8
Alabama: Dallas	1,000	1.04	101.75	217.9	0	217.9
Mississippi: Lauderdale	800	1.16	96.75	146.75	0	146.75
Florida: Manatee	575	.43	57.25	57.25	6.4	63.65

[1] Built partly with State convicts.

[2] Built entirely with State convicts.

TABLE 2.—*Road mileage*—Continued.

State and county.	Road mileage (per cent of grand total).			Character of surface.	Cost per mile.
	Surfaced only.	Graded only.	Graded or surfaced.		
Virginia:					
Spotsylvania	20.6	0	20.6	Sand-clay	[1] $1,150–$1,500
				Gravel	[1] 2,000– 2,500
Dinwiddie	19.3	0	19.3	Gravel, sand-clay, top-soil	1,300– 1,700
Lee	10.0	13.3	23.3	Earth	[1] 3,000– 3,500
				Macadam	[1] 6,000– 7,000
Wise	27.7	20.9	48.6	Earth	5,700
				Macadam	9,200
				Bituminous surface treatment.	400
New York: Franklin	28.2	0	28.2	Gravel	1,900– 2,500
				Macadam	3,000– 4,000
Alabama: Dallas	21.7	0	21.7	Gravel	3,000– 3,600
				Sand-clay	1,500– 1,800
Mississippi: Lauderdale	18.3	0	18.3	Gravel-macadam	4,000– 6,500
				Sand-clay	1,700– 2,000
Florida: Manatee	9.9	1.1	11.0	Marl-rock macadam	3,800
				Flint-rock macadam	4,700
				Shells	2,400

TABLE 3.—*Road bonds and taxation data.*

State and county.	Bonded debt incurred for roads.			Term of bonds in years.	Interest rate on bonds.	Average rate of tax per $100 of assessed valuation.			
	Total to 1915, inclusive.	Per capita.	Per $100 assessed valuation. (1915)			All purposes.		Road bonds.	
						1910	1915	1910	1915
Virginia:					*Per ct.*				
Spotsylvania	[1] $173,000	$10.93	$4.97	[2] 5–30	4½–5	$1.20	$1.70	[3] $0.45	$0.625
Dinwiddie	105,000	2.66	1.75	[4] 20–30	5–6	1.20	1.20	0	.10
Lee	455,000	19.08	9.15	[5] 5–26	5½	1.40	1.96	0	.61
Wise	960,000	28.10	7.04	[4] 20–30	5	1.40	1.762	0.30	.562
New York: Franklin	500,000	10.92	3.66	[5] 10–50	4½–5	(6)	(6)	(6)	(6)
Alabama: Dallas	350,000	6.57	2.48	[7] 30	5	1.35	1.40	0	[8] .176
Mississippi: Lauderdale	500,000	10.65	3.08	[5] 10–25	5–5½	1.54	1.66	0	.16
Florida: Manatee	250,000	26.17	3.09	[7] 30	5	2.65	2.60	.70	.30

[1] Amount authorized but only $140,000 sold.
[2] Callable after 5 years.
[3] Average for two districts only.
[4] Deferred serial with sinking-fund provision.
[5] Deferred serial.
[6] Taxes levied by towns and vary in each.
[7] Sinking fund.
[8] No special levy made for road bonds, but an average rate of 17.6 cents on the $100 will pay interest and create sinking fund with which to retire bonds in 30 years.

SPOTSYLVANIA COUNTY, VA.

Two districts in Spotsylvania County, Va., on November 2, 1909, voted an aggregate of $100,000 in bonds for the construction of improved roads. For 44 years following the close of the Civil War the farm land in the county had been allowed gradually to revert into a wilderness of second-growth timber, and it was not uncommon to see great stretches of woodland with traces of ancient furrows still visible. Lands were held at from $5 to $15 per acre,

with few buyers even at those figures. Most of the agricultural products which the farms in the county were capable of producing were brought in by rail from the outside, and thus steadily the balance of trade was rising against the county. Its greatest source of wealth—namely, timber and crossties—could not be utilized to the best advantage because the roads for many months in the year were almost impassable. The economic studies to ascertain the relative benefits and burdens of the road improvement in the county were begun in 1910 and continued annually thereafter up through 1915. A significant incident on the first inspection trip, March, 1910, occurred within a half mile of Fredericksburg, when the horses broke a singletree in their attempt to pull the light surrey, with its two passengers and driver through the deep, heavy, clay mud. (See Pl. III, fig. 1.)

While it seemed apparent at the outset that the building of a system of improved roads would be highly beneficial to the county, it remained to be seen whether the financial outlay involved would be heavier than the corresponding benefits received and whether good management and sound economy would be practiced, so as to get the greatest possible results for the outlay of funds. Only by determination of these questions could the example of Spotsylvania County be made useful to other communities which should find it necessary to deal with the subject of road improvement. As the investigations were begun before any initial steps were taken in the matter of management or construction, it was practicable to record year by year the story of Spotsylvania's good-roads progress and the economic results of the project.

It might be well to mention that Spotsylvania County is located about 45 miles north of Richmond and has an area of 401 square miles. The principal products are timber and crossties, although the farms produce some bright tobacco, hay, potatoes, truck, small fruits, etc., and since the roads have been improved there has been some development of the dairy and poultry industries. There are no large manufacturing industries and no cities except Fredericksburg, which had a population in 1910 of 5,874 out of a total population for the county of 15,809. Primarily the problem was to provide a system of roads which, while used for hauling the forest products, gradually would develop the agricultural resources of the county.

HOW THE IMPROVEMENT WAS FINANCED.

Owing to the fact that under the Virginia law cities are not taxable for county purposes, Fredericksburg, the only city in Spotsylvania County, could not be reached for a proportionate share of the proposed outlay. There were four districts in the county, but only two, namely, Courtland and Chancellor, actively took up the move-

ment. In consequence the financial burden rested at the outset entirely upon the two districts named, although traffic from the other two districts passed over the roads of these two in going to and from Fredericksburg. In spite of these drawbacks, Courtland district voted $60,000 and Chancellor district $40,000, and the bonds were sold at intervals between February 8, 1910, and September 17, 1912. The first $18,700 issued carried 4½ per cent interest and the remainder carried 5 per cent interest, payable semiannually. All of the bonds were to run 30 years, but were callable after 5 years. In all cases the bonds brought par and accrued interest. Callable bonds ordinarily do not bring as high a price in the bond market as noncallable bonds which are payable at definite periods. This indicates that the bonds were marketed shrewdly and intelligently. Arrangements were made to secure 3 per cent interest from the banks on sinking funds. Even then marketing of the bonds would not have been accomplished except for the loyal support given by local investors. Furthermore, as pointed out in the preceding chapter of this bulletin, the combination of long-term and a call provision leaves so much to the discretion of the local authorities from year to year as to inject an element of uncertainty into the matter of bond retirement and tax levies. It might readily occur that when officials are in authority who are actuated by an eagerness to get the district out of debt, an excessive tax rate would be levied and the bonds called in at an unnecessarily rapid rate; or the reverse might be true if negligent officials, or those who, for any reason, might desire to hold the tax rate down to a minimum, should neglect to call in bonds. The district then would carry the burden represented by the difference between the 3 per cent obtained on sinking fund and the 5 per cent carried by the bonds. It would have been better if a 5–30 year deferred serial bond had been adopted, as the annual retirement then would have been fixed and the tax rate subject to no wide fluctuation.

Our subsequent investigations enabled us to see just what financial steps were taken in connection with the bond issues. As the bonds were not callable until after 5 years, it followed that the first call year was 1915. If it were intended that the payment on the debt should begin in 1915 and extend to the thirtieth year the logical plan for Courtland and Chancellor districts would be to pay off $4,000 of the principal each year, from the sixth to the thirtieth year. For the two districts for 1915 this would require an average rate of 32.7 cents on each hundred dollars of taxable valuation for interest and principal for the 30-year period. Of course this rate would decrease as the assessment increased at 5-year intervals.

The plan actually followed in Courtland district was to levy 40 cents on the hundred dollars for 1910 and 1911; for 1912, 45 cents; for 1913,

70 cents; for 1914, 35 cents; thus producing a total of $25,243.49, to which should be added whatever was obtained from the 3 per cent allowed by the banks on sinking-fund deposits. Inasmuch as the interest for the first 5 years amounted to only $14,517.50, this left $11,725.99 plus the interest on the sinking fund. With this amount, $11,000 of the bonds had been retired at the beginning of 1915. A levy of 65 cents on the hundred dollars was made in 1915, from which $9,917.50 was obtained, and on December 13, 1915, the bonded debt was further reduced to the extent of $2,000. At the rate of payment and taxation thus far adopted, the district will be out of debt long before the expiration of the 30-year term; but whether this rapid payment is desirable under all existing conditions must remain a matter of judgment.

An inspection of tax rates shows that in 1910 the taxpayers of Courtland district paid, exclusive of the 40 cents levied for road bonds, a total of 95 cents on the hundred dollars, or a total for all purposes, including State, county, and road-bond taxes, of $1.35, of which the bond taxes formed 29.6 per cent. The levying of a 65-cent tax rate in 1915 made the total tax for that year $1.70 on the hundred dollars. Thus the road bonds in 1915 formed 38.2 per cent of all taxes paid in Courtland district. In both years the general road and bridge tax was 15 cents on the hundred dollars.

To see how this would affect the individual taxpayer, let us assume that a man owns a $5,000 farm, which is assessed at $3,000, or a little more than the usual basis of assessment in the county. He will pay taxes for all purposes in 1915 at $1.70, a total of $51, of which $19.48 will represent his share of the tax for the improved roads. This 65-cent rate is higher than the average, however, and it would seem more equitable to estimate his tax burden at 40 cents on the hundred dollars, as was levied in 1910. This would make his annual outlay for the improved roads $12. Against this cost he must place the saving in wear and tear of his teams and wagons, the opportunity which he has gained of hauling larger loads, of doing his hauling at all seasons of the year, and of saving time in making his trips to market. It is safe to say that the average possessor of a $5,000 farm would gladly pay such a tax per year in return for a guarantee of these benefits.

Chancellor district, which voted $40,000 in bonds, levied a still higher rate of tax for bond purposes than Courtland, as the rate was 50 cents for 1910 and 1911, 55 cents for 1912, and 65 cents for 1913, 1914, and 1915. The total tax rate for 1910 was $1.40 for all purposes, State, county, and bonds, and in 1915 was $1.85. Thus the bond-issue tax comprised 35.7 per cent of the total in 1910 and 35.1 per cent of the total in 1915. During the 5-year period from 1910 to 1914, the district raised $15,865 to apply to the bonds, of which

about $9,500 was needed for interest, leaving about $6,360, plus interest obtained on sinking fund, to apply on the principal. From this sum $4,000 of the bonds were retired by 1915, and after the 1915 levy was obtained, which yielded $4,838, a further $2.500 of bonds were retired.

While more than ample provision was made for rapidly paying off the bonds, no steps were taken in either district properly to maintain the roads after the completion of the system. It was soon found that if the roads were to be prevented from going to destruction and the investment thus dissipated, it was necessary that funds be provided for maintenance. As the tax rates were already high, the situation was met by the establishment of toll gates. The operation of the toll system, described elsewhere in this chapter, produced an amount equivalent to that which would be obtained by a tax levy of 31 cents on the hundred dollars of the 1915 assessed valuation, if levied against the whole county, or 50 cents if levied against Courtland and Chancellor districts alone. After deducting that portion of the toll funds which was applied to new construction, the funds actually applied to maintenance were still sufficient in amount to be equivalent to a sum which could be raised by a tax rate of 17.4 cents on the hundred-dollar valuation, for the whole county, or 28.1 cents for these two districts alone. Possibly a lower rate for the bond retirement and the application of the saving thus made to the maintenance of the roads might have been desirable rather than the establishment of the toll system, but the existence of other factors, however, bearing upon the subject of tolls in Spotsylvania County complicate the question so that it can be dealt with by the local community only as a special problem.

OTHER DISTRICTS VOTE BONDS.

Stirred by the example of Courtland and Chancellor districts, the two other districts in the county, namely, Berkley and Livingston, voted $40,000 and $33,000 respectively in 1913.

COUNTY VALUATIONS AND REVENUES SHOW LARGE INCREASE.

In 1910 the tax rates for all purposes, including State tax of 35 cents, were respectively, $1.35 for Courtland, $1.40 for Chancellor, $1 for Livingston, and $1.05 for Berkley, or an average of $1.20 for the county, with a total revenue production of $31,571. The rates had increased in 1915 to $1.70 in Courtland, $1.75 in Chancellor, $1.45 in Livingston, and $1.90 in Berkley, or an average of $1.70, with a total revenue produced of approximately $59,100. It is interesting to note, therefore, that while the tax rate increased 41.6 per cent in the period from 1910 to 1915, the revenue increased 87.2 per cent. This is due to the very large increase in the assessed valuation of property since the road-building program was begun, and

shows that while the people are paying taxes at a higher rate, they are obtaining far more in the form of revenue for public purposes than the increase in the tax rate ordinarily would have yielded. As an index to the prosperity of the county since the completion of the road system, it might be pointed out that the taxable valuation in 1905 was $1,738,727; in 1910, $2,120,753; and in 1915, $3,478,373. The increase in the five-year period from 1905 to 1910, the year road improvement was begun, was only 21.9 per cent, the increase in the corresponding period from 1910 to 1915 was 63.9 per cent. Probably a better conception of this increase can be gained through the statement that the aggregate of the bond issues for the four districts, comprising the sum of $173,000, is less than one-eighth the increase in valuation with a considerable portion of these bond issues yet to be expended.

HOW THE WORK WAS MANAGED.

The funds derived from the bond issues in Chancellor and Courtland districts were expended under the direction of the special board of public roads of Spotsylvania County, and a resident engineer, at $1,200 per annum, who was appointed by the State highway commissioner for the period of construction only. The board consisted of four members appointed by the judge of the circuit court for a term of three years. Each member was paid $100 a year, except the secretary-treasurer, who was paid $125. Orders for expenditures originated with the engineer in charge and were approved by the board. A similar board has charge of the work in Livingston and Berkley districts.

The roads to be improved were designated by the judge of the circuit court in the order of election. When the improvement is completed and accepted by the State highway department and county road board, the roads are turned over for maintenance to the county board of supervisors, composed of one supervisor from each magisterial district, elected for a term of 4 years, and receiving a compensation of $4 per day for time actually employed.

Under the Virginia law all roads built by means of bond issues are under the direction of the State highway department as to surveys, plans, specifications, and supervision of construction. The State also grants aid in the form of cash or convict labor to the extent of one-half the cost of the roads, but as the amount of cash annually available from the State is small, it will probably require a number of years to reimburse this county to the extent of one-half the total outlay. The State money aid was not expended on the bond-issue roads, but on other roads, and is only mentioned to make clear the relation between the bond-issue funds and the State-aid allotments. From 1909 to 1915 a total of $8,212.01 in money aid and automobile licenses has been received by the county.

The regular road work of the county is carried on under the direction of a superintendent appointed by the board of supervisors and receiving a salary of $1,200 per annum, house rent free, and transportation. The superintendent hires all labor and teams and purchases machinery, equipment, and materials on the approval of the board of supervisors.

Three main highways radiating from Fredericksburg and aggregating, with their branches, 39.5 miles, were selected for improvement and the actual routes were set forth in the order of election. These roads, located in Courtland and Chancellor districts, were improved from funds derived from the $100,000 bond issues for those districts, the amounts apportioned to each district being in accordance with the proportionate mileage in each. The first contract was awarded in July, 1910, and the last mile of road was completed in these two districts in September, 1913. By actual measurement the roads improved aggregated 40.89 miles, or 1.39 miles more than originally contemplated. This, of itself, was an unusual showing, but an even more striking evidence of the economy exercised was the fact that enough money remained of the original $100,000 issued to construct an additional gravel road between Spotsylvania Courthouse and the southern boundary of Courtland district, a distance of 2.3 miles. This was completed in August, 1913, making a total mileage of roads completed under the bond issue in Courtland and Chancellor districts of 43.19 miles, or a little over 10 per cent of the total of 400 miles of road in the county.

The average cost per mile, including culverts and bridges, was $2,319.21. As an example of the great improvement in bridges, see Plate IV. The roads were all constructed of gravel, except 1.7 miles of water-bound macadam, which was surfaced with gneiss of a very poor quality. This section has worn badly and most of it has since been resurfaced with gravel. The gravel used on the improved road system was composed of quartz pebbles, quartz sand, and clay of fairly good wearing quality. Table 4 is a detailed report on dimensions and costs and was supplied by the State highway commissioner of Virginia.

TABLE 4.—*Mileage and cost of roads built.*

CHANCELLOR DISTRICT.

Name of road.	Length of road.	Width of roadway.	Width of gravel.	Expended on road.	Rate per mile.
	Miles.	*Feet.*	*Feet.*		
Plank	5.250	20	14	$8,410.91	$1,602.08
Pike	4.772	20	14	9,224.05	1,932.95
Gordon	3.9	20	14	9,272.38	2,377.53
Catharpin	4.29	20	14	10,953.87	2,553.35
	18.212	20	14	37,861.21	2,080.27

TABLE 4.—*Mileage and cost of roads built*—Continued.

COURTLAND DISTRICT.

Name of road.	Length of road.	Width of road-way.	Width of gravel.	Width of macad-am.	Expend-ed on road.	Expend-ed on culverts and bridges.	Rate per mile, in-cluding culverts and bridges.
	Miles.	*Feet.*	*Feet.*	*Feet.*			
Plank	3.039	20	14	[1] 20	$4,968.45	$1,173.19	$2,020.94
Spotsylvania Courthouse to Gayles Bridge	1.7	20–24	.....	[2] 14	12,441.00	.....	7,318.23
River	3.106	20	14	.....	6,250.89	640.40	2,218.70
Fredericksburg-Spotsylvania Court-house	10.05	20	14	.....	19,538.21	208.00	1,964.80
Telegraph Road from Fredericksburg; Courthouse Road to Massaponax	4.55	20	14	.....	10,886.55	688.27	2,543.92
Hazel Run-Plank	.223	20	14	.....	1,213.20	.....	5,440.36
Spotsylvania Courthouse-Snell's Bridge	2.310	20	14	.....	[3] 4,297.49	.....	1,860.38
	24.978	.....	.....	.....	59,595.79	2,709.86	2,494.40

[1] For 424 feet. [2] For 8,525 feet.

[3] Includes 2,206.6 convict-labor days. Convict camp maintained at a cost of $1,272.41, which is included in the above.

In Berkley district 25.54 miles of gravel road were constructed with the proceeds of the $40,000 bond issue, supplemented by convict labor furnished by the State. The convict labor aggregated 15,242.5 labor days. The district paid the actual cost of 7,425 convict days at 55 cents, or a total of $4,083.75, while the State paid the actual cost of 7,817.5 convict days at 55 cents, or a total of $4,299.62. These roads therefore cost an average of $1,119.43 per mile, including cash and actual cost of maintaining the convicts.

Livingston district has under construction 34 miles of soil roads, which, on the basis of 8 miles already completed, are costing $1,155.88 per mile.

SUMMARY OF MILEAGE.

Thus far 76.73 miles of road have been improved in the four districts at an average cost, including cash outlay by all the districts and convict labor furnished two districts by the State at actual cost, of $1,944.52 per mile, while the total outlay on this basis has reached $149,198.80, of which the State's share in convict labor amounted to $6,889.15 on basis of actual cost. When the road improvement has been completed in Livingston district the county will have 102.73 miles of improved roads, or about 25 per cent of the total mileage. (See Pl. II.)

TOLL SYSTEM OF MAINTENANCE ADOPTED.

The first year after the roads were improved the surfaces were rather sticky and muddy in wet weather, but this condition almost entirely disappeared after the second year, when the surplus clay had leached out. The roads are now generally in good condition.

Very little was done in the way of maintenance until 1914, on account of lack of funds. Because of opposition to a special levy for maintenance, the board of supervisors determined to raise the necessary maintenance fund by means of tolls, for which authority was secured from the General Assembly of Virginia.

On August 10, 1914, three toll gates were established, one on the Courthouse Road, one on the River Road, and one on the Chancellorsville Road, for which toll rates for round trips were fixed as follows: Single horse and vehicle, 5 cents; 2 horses and buggy, 10 cents; 2 horses and wagon, 15 cents; 4 horses and wagon, 25 cents; Ford automobiles, 20 cents; other automobiles, 25 cents to 35 cents. During the week of August 10–16, 1914, $258.77 was collected in tolls, and on September 1 the toll rates on the Chancellorsville and River Roads were reduced one-half. The gross total collected in tolls during the first year of operation amounted to $10,800, of which $2,599.30, or 24 per cent, was received from automobiles. In order to raise this amount of money by direct tax it would be necessary to assess an additional tax on all of the taxable property of about 30 cents on the hundred dollars. As the total length of road on which tolls were collected was 43.2 miles in Courtland and Chancellor districts, this gave an annual gross amount per mile of $250. From the gross amount of $10,800 must be deducted $1,740 for collection and overhead, leaving $210 per mile for actual maintenance.

The total expenses of collection and overhead amounted to $145 per month, as follows: Two collectors at $45 per month each and one collector at $40 per month; oil, tickets, fuel, etc., $5 per month for each of the three gates. There is no overhead charge for supervision, as the gatekeepers report to the county superintendent of roads, whose salary is paid from the regular county funds. Out of the tollgate receipts the River Road was extended 3 miles at a cost of about $1,200, and 3 additional miles were built in different parts of Chancellor and Courtland districts, at a cost of $1,800, leaving $6,060, which was used in resurfacing the Courthouse Road 11.75 miles, at an average cost of $515 per mile.

The maintenance forces of the county under which this work was done consisted of two gangs with a foreman in charge of each gang. Both gangs used on the average 10 teams, four of which were owned by the county, one 10-ton roller, owned by the county and paid for out of the county funds, and from 14 to 15 men. The foremen of the gangs received $2 and $2.50 per day, respectively, and laborers were paid $1 per day and board, or $1.25 without board. Team hire was $3 per day without driver, and the cost of maintenance of county-owned teams averaged about $1 per day.

This maintenance situation emphasizes the disinclination on the part of local communities to submit to taxation for the purpose of keeping up their roads after they have gone to considerable expense to build them. The toll system appeals to them as a simple way out of the difficulty and furthermore as a means of reaching the lumber dealers and automobilists who come from other districts, counties and States.

EFFECT OF ROAD IMPROVEMENT ON LAND VALUES.

To ascertain as nearly as possible the effect of the road improvement on land values, a careful record was made in 1910 of the actual market value of 35 farms located on the roads selected for improvement. The total number of acres in these 35 farms was 5,518 and the total market value at that time was $77,950, or $14.13 per acre, including buildings. In the same year the average value of all land in the county, including buildings, was reported by the United States census to be $13 per acre, thus indicating the accuracy of the data obtained by our investigation. As the road improvement had not been completed in 1911, no inquiry was made in that year as to land values, but in subsequent years careful investigation was made as to the values of the 35 farms recorded in our 1910 investigation. It was found that in 1912, 7 of the 35 farms had been sold and that an offer had been made and refused for another one of the original number. How the values had increased in the brief period of about 2 years may best be indicated by the history of these 7 cases.

A farm 3 miles from Fredericksburg, containing 139 acres and valued at $3,500 in 1909, was sold in 1912 for $5,000, an increase over the 1910 valuation of 43 per cent.

A farm 10 miles from Fredericksburg, containing 420 acres, listed at $6,000 in 1910, sold for $8,250 in 1912, an increase of 37 per cent over the 1910 valuation.

A farm 11 miles from Fredericksburg, containing 110 acres, valued at $1,500 in 1910, brought in 1912 $2,000 for 80 acres and $500 for timber, an increase of 60 per cent without counting the value of the remaining 30 acres, or about 116 per cent, counting this acreage at its 1912 sale value.

A farm 2 miles from Fredericksburg, containing 101 acres, valued at $3,000 in 1910, sold for $3,750 in 1912, an increase of 25 per cent.

For a farm 6 miles from Fredericksburg, containing 475 acres, valued at $5,000 in 1910, $12,500 was refused during the latter part of 1911, an increase of 150 per cent.

The five farms above referred to are located on the Fredericksburg-Spotsylvania Court House Road

A farm 4 miles from Fredericksburg, on the Massaponax Road, containing 357 acres, valued at $2,800 in 1910, was sold at forced public sale in 1912 for $4,400, an increase of 76 per cent.

A farm 3 miles from Fredericksburg, on the Plank Road, containing 133 acres, valued at $7,000 in 1910, sold for $10,000 in 1912, an increase of 43 per cent.

Another farm, 3 miles from Fredericksburg, on the Plank Road, containing 100 acres, valued at $3,000 in 1910, was sold for $4,750 in 1912, an increase of 58 per cent.

It is thus evident that in this little group of sales the increase in value according to the actual record obtained was $20,100, or 63.2 per cent, over the 1910 value. The average value, after the roads were improved, was $28.26 per acre, as compared with $17.31 previous to the improvement.

A confirmation of the 1912 data on land values was obtained in 1913, at which time it was found that four transfers of farm land, which took place in that year on improved roads from 5 to 10 miles from Fredericksburg, were on the basis of $30.11 per acre, whereas they were listed in 1910 at $13.89 per acre. It was learned in 1913 that some of the farms which had been practically abandoned by their owners as places of residence had been reoccupied. One farm owner moved to New England and rented his farm on the Chancellorsville Road. Returning in 1913 to make some repairs, he found the farm so conveniently located on the improved road that he moved back from New England.

In February, 1914, another inspection of the roads was made and a further confirmation of the effect of the improvement on land values was obtained. This 1914 record was as follows:

A farm containing 136 acres, valued at $6,000 before the roads were improved, was sold after the roads were improved for $12,000, an increase of 100 per cent.

For a farm containing 133 acres, valued at $7,000 before the roads were improved, an offer of $10,500 was made and refused after the road was improved, an increase of 50 per cent.

A farm on the River Road, containing 312 acres, which sold in 1908 for $4,500, was again sold for $10,500 in 1913, an increase of 133 per cent.

A farm on the River Road, containing 870 acres, sold for $18,000 shortly before the road was improved and was sold again for $31,000 in 1914, an increase of 72 per cent.

It appears that the 1,451 acres increased in value $28,500, or 80 per cent, or from $24.46 to $44.10 per acre, and it is believed that this increase was caused very largely by the improved roads.

Taking the two groups of sales and combining acreage and value, we get a total of 3,286 acres, with a total original value of $67,300

and a total sale value after the roads were improved of $115,900, showing an average value per acre before improvement of $20.48 and an average value after improvement of $35.27, or a general average of 70.2 per cent increase in value.

In order to ascertain whether or not the increase in land values was general throughout the county, or whether it was confined to the improved roads, we obtained in the fall of 1915 values of three typical farms on unimproved roads where the land was comparable in agricultural fertility with land on the improved roads.

A farm in Livingston district, containing 1,000 acres, 12 miles from an improved road, was sold at $7 per acre in 1914.

Another farm in Livingston district, 10 miles from the improved road, containing 148 acres, was sold in 1915 for $9.45 per acre.

A farm in Berkley district, 12 miles from the improved road, containing 190 acres, was sold in 1915 for $4.73 per acre.

These three farms were stated by competent authorities to be typical of values on the unimproved roads, and if the average of $6.89 per acre for the three farms is compared with the average of $35.27 per acre for the sales on the improved roads, it seems reasonably conclusive evidence that the roads have been a most important factor in the increase of farm values.

On the whole, it appears that the land along the improved roads increased in value an average of about 70 per cent, due far more to the road improvement than to any other cause.

Again, it was acertained from the dealers in real estate that very few farms had been sold in the county except those located on or near the improved roads and that the increase in land values was confined almost entirely to the improved road sections. Real estate dealers in Fredericksburg asserted that they had sold more farms on the improved roads during the single year 1911–12 than in all the rest of the county combined during the preceding five years. They stated further that prospective buyers had, in many cases, refused to look at farms located on unimproved roads. Considerable areas of farming land along the improved roads are now being cultivated for the first time since the Civil War. Several tracts of land which were covered with forest growth or brush when the first inspection was made in 1910 have since been cleared and are now being cultivated. A series of photographs, taken of the same location each year since 1910, illustrates this fact. (Pl. I, figs. 1–4.)

EFFECT OF ROAD IMPROVEMENT ON TRAFFIC DEVELOPMENT.

To obtain basic data covering the development of the agricultural and forest resources of the county and to aid in determining the effect of the road improvement on such development, a careful record of incoming and outgoing shipments of farm and forest products at

Fredericksburg, the principal market and shipping point, was obtained for the years 1909 and 1913, these being the years, respectively, before the improvement was begun and after it had been fairly well completed. The 1909 record showed a total of incoming farm products of 10,520.1 tons, while the outgoing farm products amounted to only 7,255.1 tons, the balance of trade being, therefore, against the county to the extent of 3,265 tons. The 1913 inquiry indicated that up to that year there had been no favorable change in the ratio of incoming to outgoing shipments, as the total incoming amounted to 15,169.8 tons, an increase over the 1909 figures of 44.2 per cent, while the outgoing amounted to only 7,869 tons, an increase over the 1909 figures of 8.4 per cent. The explanation of this continued lethargy in the matter of agricultural development is found in a reference to the shipments of forest products. In 1909 the total forest products shipped out by rail and water at Fredericksburg was 71,915.2 tons, while in 1913 the total had increased to 128,219.2 tons, an increase of 56,304 tons or 78.2 per cent. It is evident that the people are devoting their first attention to realizing upon their great wealth of forest products, leaving the agricultural development to come later. It is worthy of mention, however, that the 1913 record as compared with 1909 shows an increase in the outgoing egg shipments of 77.3 per cent, and in the dairy products an increase of 110 per cent. Most of the farm products which are bought outside the county can be produced on the home farms, and it is quite probable that with the excellent transportation system afforded by the improved roads farming gradually will be developed and the balance of trade ultimately be in favor of the county instead of against it.

Considering the data of freight shipments as an index to determine the increase in traffic hauled on the country roads, it would indicate that this increase between 1909 and 1913 has approximated 70 per cent. To ascertain, however, the volume of traffic before and after improvement of the roads and the effect of the road improvement on the cost of hauling, records were made of the traffic encountered on the roads at each of the annual inspections, extending from 1910 to 1915. The following record (Table 5) of traffic encountered on the roads in March, 1910, indicates strikingly the poor condition of the roads and the excessive burden imposed upon traffic in delivering even small quantities of products at markets:

TABLE 5.—*Approximate weight of traffic encountered on roads in Spotsylvania County, Va., in March, 1910.*

	Pounds.
1-horse wagon loaded with 2 cross-ties	400
1-horse wagon loaded with 4 cross-ties	800
1-horse wagon loaded with 4 cross-ties	800
2-horse wagon loaded with 2 crates of chickens	150
2-horse wagon loaded with 5 cases of eggs	500

	Pounds.
2-horse wagon loaded with $\frac{1}{8}$ cord of stove wood	500
2-horse wagon loaded with 3 cross-ties	600
2-horse wagon loaded with barbed wire	800
2-horse wagon loaded with $\frac{1}{4}$ cord of stove wood	1,000
2-horse wagon loaded with $\frac{1}{4}$ cord of stove wood	1,000
2-horse wagon loaded with $\frac{1}{4}$ cord of stove wood	1,000
2-horse wagon loaded with 6 cross-ties	1,200
2-horse wagon loaded with merchandise	1,400
2-horse wagon loaded with pine lumber, 500 feet	2,000
3-horse wagon loaded with 12 cross-ties	2,400
3-horse wagon loaded with 15 cross-ties	3,000
Average weight of load	1,097

An analysis of four of these cases gives the following interesting details:

	Pounds.
1-horse wagon loaded with 4 cross-ties	800
(8-mile haul, 1 day to make trip, 3.2 ton-miles, estimated cost per ton-mile, $0.625.)	
3-horse wagon loaded with 15 cross-ties	3,000
(13-mile haul, 1 day for trip, 19.5 ton-miles, estimated cost per ton-mile, $0.205.)	
3-horse wagon loaded with 12 cross-ties	2,400
(10-mile haul, 1 day for trip, 12 ton-miles, estimated cost per ton-mile, $0.33.)	
2-horse wagon loaded with pine lumber, 500 feet	2,000
(10-mile haul, time from 7 a. m. to 3 p. m., 10 ton-miles, cost per ton-mile, $0.30.)	

On the basis of $2 per day for single teams, $3 per day for double teams, and $4 a day for three-horse teams, for the four cases in which complete information was secured, the average cost for the 44.7 ton-miles moved was 29 cents per ton-mile. For the entire 16 cases referred to the cost per ton-mile would be much higher, as most of them represented only partial loads. (See Pl. V, fig. 1.)

In the winter and spring months the average weight of load for a two-horse team was about 20 bushels of grain, or about 1,200 pounds. When the roads were dry, 40 bushels of grain, or 2,400 pounds, made an average load. On the basis of a 10-mile haul, and $3 per day for man and team, the cost would be 25 cents per ton-mile on the roads when dry, 50 cents when the roads are wet and muddy, and at least 30 cents for the year around.

The 1912 inspection was made March 19, 20, and 21, after the road from Fredericksburg to Spotsylvania Court House, $11\frac{3}{4}$ miles, had been completed. The average load for a two-horse team on this road was now found to be 1,000 feet of lumber, or about 4,000 pounds. On the basis of a 10-mile haul, and $3 per day for man and team, the cost was 15 cents per ton-mile.

It was noticed that many teamsters were accustomed to loading 1,000 feet or more of lumber on narrow-tired wagons, which resulted in considerable damage to the roads, especially in wet weather. To prevent this damage the county supervisors passed an ordinance limiting loads of lumber to 1,000 feet, or 4,000 pounds, on wide-tired vehicles, and to 600 feet on narrow-tired wagons. As a result of this ordinance most of the teamsters have provided themselves with wide-tired vehicles, 3-inch tires for 2-horse vehicles and 4 to 6 inch tires for 4-horse vehicles. Since the roads have been improved drivers frequently hitch two wagons together and use 4-horse teams, hauling 1,000 feet on each wagon if equipped with wide tires, or 600 feet on each wagon if equipped with narrow tires. On account of the ordinance limiting the weight of loads, it was difficult to secure from the drivers exact information on this subject. As a matter of fact, many of the teamsters hauled more than the law allows, and several of them have been indicted for violating the ordinance.

It was found that on the improved roads some wagons carried manure, hay, or merchandise on the return trip. For instance, on this inspection trip it was observed that one lumber team, on returning home 3½ miles, carried 1½ tons of manure. Another 2-horse lumber team returned with a 2,300-pound load, 3½ miles. Still another team was seen making the 12-mile home trip with 1 ton of hay. Heavy hauling is now done on these roads all the year round, but before the roads were improved it was impossible to do heavy hauling at all at certain seasons of the year; the roads were simply impassable, except for light vehicles and those who traveled on horseback. Where teams are enabled to travel both ways loaded the cost per ton-mile is lowered about one-half.

The inspection made between April 2 and 12, 1913, showed that traffic conditions had further improved, and instances were repeatedly met with showing that the improved roads had materially bettered marketing conditions.

The character of products hauled, weight of loads, distance hauled, and cost per ton-mile of a portion of the traffic noted during the 1913 inspection is shown in Table 6.

TABLE 6.—*Hauling data for loads met on roads, Apr. 2 to 12, 1913.*

Vehicle and load.	Weight.	Distance hauled.	Ton-miles.	Cost for trip.	Cost per ton-mile.
Double team:	*Tons.*	*Miles.*			*Cents.*
20 ties	2.00	8	16.0	$2.00	12.5
1,000 feet lumber	2.00	8	16.0	2.00	12.5
21 white-oak ties	2.10	11	23.1	3.00	13.0
1,000 feet lumber	2.00	6	12.0	1.50	12.5
1,300 feet lumber	2.60	11	28.6	3.00	10.5
20 white-oak ties	2.00				
900 feet lumber	1.80	7	12.6	1.50	11.9
1,500 feet lumber	3.00	11	33.0	3.00	9.1
1,100 feet lumber	2.20	8	17.6	2.00	11.3
1,000 feet lumber	2.00				
Do	2.00				
Do	2.00	15	30.0	3.50	[1]11.7
11 ties	1.10				
¾ cord wood	1.50				
13 ties	1.30	12	15.6	3.00	19.2
1,000 feet lumber	2.00	12	24.0	2.50	[2]10.4
4-horse team:					
1,500 feet lumber	3.00				
2,000 feet lumber	4.00				
Do	4.00	10	40.0	3.00	[3]7.5
Single team:					
5 ties	0.50				
6 ties	0.60				
Do	0.60				
400 feet lumber	0.80				
500 feet lumber	1.00	6	6.0	1.50	25.0
Average for 13 loads	2.15	9.6	20.6	2.423	11.76

[1] Teamsters get $3.50 per 1,000 feet for this haul and make 1 trip a day.
[2] Teamsters get $2.50 per 1,000 feet and make 1 trip a day.
[3] On basis of 1¼ trips per day; round trips made in 7 hours.

Of the 13 cases for which complete information was obtained it appears that the average load for a 1-horse team was 1,400 pounds, for a 2-horse team 3,950 pounds, and for a 4-horse team 7,333 pounds; the average distance hauled was 9.6 miles, thus making the average cost 11.7 cents per ton-mile.

The 1914 study made on February 9 and 10 showed that the improvement of the road from Partlows to Spotsylvania Court House had opened up a large territory from which lumber and ties could be profitably hauled through to Fredericksburg. In 1913 large quantities of ties and lumber were brought to Spotsylvania Court House from the surrounding country and there reloaded in bigger loads, from which point they were hauled to Fredericksburg with 2-horse teams. In 1914 this point of transfer was moved farther out on account of the improved road, which will increase the average haul for such products and reduce the cost of marketing.

The traffic encountered between 8.15 a. m. and 11 a. m. on February 10, 1914, on a trip from Fredericksburg to Spotsylvania Court House comprised 62 vehicles, 44 of which were loaded with lumber, ties, etc., going to Fredericksburg. For 6 cases on which complete information was obtained the average load was 2.38 tons, the average distance was 12 miles, the average ton-miles for each team per day was 28.5, and the average cost per trip about $3.50, making the average cost about $0.12 per ton-mile. (See Pl. V. fig. 2.)

Traffic Census.

In order to verify and complete data as to the volume of traffic and the cost per ton-mile on the different roads, three traffic takers for Spotsylvania County were appointed in the early part of 1914. The census covered one week in March and July, respectively, including Sundays, two weeks in December, 1914, excluding Sundays, and one week in April, 1915, including Sunday.

The traffic area served by these roads covers practically the whole county, which contains 360,680 acres. There is some traffic from Caroline County, but this does not sensibly affect the total.

The results of these censuses are shown in Table 7, in which attention is called to the fact that the average haul includes the distance on both the improved and unimproved roads.

Table 7.—*Traffic census on three improved roads in Spotsylvania County, Va.*

Road.	Average teams per day.	Average loaded teams per day.	Average tons hauled per day.[1]	Average tons hauled per year.	Average haul.[2]	Annual ton-miles.	Average cost per ton-mile.	Average motor vehicles per day.
					Miles.		*Cents.*	
Courthouse	217	79	190.4	59,460	13.42	804,564	13	26
Plank	155	45	103.4	32,266	8.5	281,796	15	16
Partlows, Mount Pleasant to Spotsylvania C. H.	73	27	49.3	15,397	9.49	158,472	14	13

[1] Based on three 6-day censuses and one 12-day census.
[2] Distance includes both improved and unimproved roads.

Practically all tonnage shown for the Mount Pleasant Road also passes over the Courthouse Road on its way to the market or shipping point at Fredericksburg. From Table 7 it will be seen that the total annual traffic over the Courthouse and Plank Roads amounts to 91,726 tons net. It is estimated that the total traffic on the River Road is about one-fourth of the total tonnage on the other two roads, or 22,930 tons annually, which makes a total traffic passing over the bond-built roads of the county of 114,656 tons net.

In ascertaining the tonnage and the ton-mileage passing over the roads no computation was made of the motor-vehicle traffic, except a count of the number of motor cars, but it is worth while to mention that on a tonnage basis and at an average weight of 1.45 tons for a total of 18,980 cars passing over the roads in the year, with an average distance traveled of 9.8 miles, the automobile traffic represented 27,521 tons, or 271,511 ton-miles, a traffic equivalent to 29 per cent of the net ton-mileage of products hauled. Thus in a strictly rural county the motor traffic has already assumed striking proportions.

The total net ton-mileage on the bond-built roads, exclusive of automobile traffic, the approximate cost of moving this tonnage before

and after the roads were improved, and the estimated annual saving, are shown in Table 8.

TABLE 8.—*Annual ton mileage and total saving on basis of tonnage hauled after road improvement, for roads improved under the bond issue.*

Road.	Tons hauled per annum.	Estimated average haul on improved road.	Average annual ton-miles.	Average cost per ton-mile.		Total cost of hauling.		Estimated gross annual saving
				Before improvement.	After improvement.	Before improvement.	After improvement.	
		Miles.		*Cents.*	*Cents.*			
Courthouse	59,460	10.00	594,600	30	13	$178,380.00	$77,298.00	$101,082.00
Plank	32,266	8.00	258,128	30	15	77,438.40	38,719.20	38,719.20
River	22,931	3.00	68,793	30	15	20,637.90	10,318.95	10,318.95
Total and average	114,657	[1] 8.03	921,521	30	[1] 13.7	276,456.30	126,336.15	150,120.15

[1] Weighted average.

The total tonnage figures for the Courthouse and Plank Roads are the same as those given in the traffic census table (Table 7), but the average haul given is for the improved roads only.

The saving in hauling costs appears to be about 16.3 cents per ton-mile, or a total of $150,120.15 annually. If from this is deducted $7,800, the present cost of maintenance, and $8,650, the annual interest charges on the total bond issue, this would still leave a total annual saving of $130,670.15, or an average net saving of 14.2 cents per ton-mile.

EFFECT OF ROAD IMPROVEMENT ON SCHOOLS.

The superintendent of schools reports a distinct increase in average attendance where the schools are located on improved roads. The percentage of attendance for certain schools located on road improved since 1910 is shown in Table 9.

TABLE 9.—*Percentage of attendance based upon total enrollment of rural schools in Spotsylvania County located on roads improved since 1910.*

Name of school.	School term.		Percentage of increase 1909–10 to 1913–14.
	1909–10	1913–14	
	Per cent.	*Per cent.*	
Lee's Hill	50	82	64
Leavell's	74	81	9
Courthouse	67	75	12
Massaponax	57	71	24
Salem	64	80	25
Colored school	41	67	63
Grange Hall, now Chancellor graded school [1]	47	81	72
Average	57	77	38

[1] This school, with two others, was consolidated into a modern 4-room building in 1912, and the figures above for 1913–14 are given for the Chancellor graded school at the Grange Hall site.

The figures given for the school term 1909–10 represent the percentage of attendance before the roads were improved and for 1913–14, since the roads were improved. The percentage of increase ranges from 9 to 72, and averages 38. The average attendance before the roads were improved was 57 per cent and in 1913–14, 77 per cent.

A consolidated school has also been established at Spotsylvania Court House, to take the place of the old school building located at that place (see Pl. VI). In 1912 there was a consolidation of several small one-room schools into one graded school on the Finchville road. It is evident that the improved roads have largely influenced the increased school attendance and the better educational facilities now offered to the country boys and girls of Spotsylvania County.

DINWIDDIE COUNTY.

Road improvement was begun in Dinwiddie County in 1908–9 through the construction of 9¾ miles of gravel road under the direction of the State highway department. On this road the county spent $12,606.76 and the State furnished convicts to the extent of 7,919 convict days at an actual cost to the State of 72 cents per convict day. This improvement caused the people to realize the vast difference between a good road and a bad road, and as a result an election was held in 1909 and the four districts of the county were bonded to the amount of $105,000.

In order to trace the results obtained through the expenditure of the bond issue, our economic investigations were begun in March, 1910, and subsequent studies were made in March, 1911, March, 1912, April, 1913, and February, 1914.

Dinwiddie County, it might be mentioned, is situated at the head of tidewater between the Appomattox and Nottoway Rivers, 22 miles south of Richmond, and has an area of 521 square miles, with a surface varying from gently rolling to level. Of the total area 79.8 per cent was in farms in 1910, but only 37.6 per cent of the farm area was improved. The principal crops are tobacco, peanuts, hay, grain, and vegetables. There are several large tracts of first and second growth timber and several sawmills are in operation.

HOW THE IMPROVEMENT WAS FINANCED.

Of the $105,000 of bonds voted, $30,000 was charged to Namozine District, $22,500 to Rowanty District, $27,500 to Darvills District, and $25,000 to Sapony District, and these amounts were expended accordingly in the respective districts. The bonds all run 30 years, but are redeemable in 20 years. Of the first bonds sold in June, 1909, $10,000 bear 5 per cent interest and $30,000 6 per cent interest, the latter selling at a premium of $3 on the hundred. The remaining $65,000 were disposed of in 1910 and bear 6 per cent interest. If the

deferred serial method, with the first bonds falling due 6 years from date of issue and the last bonds 25 years from date of issue, had been adopted, the average annual outlay for interest and retirement of bonds would be $8,044. Under the arrangement actually adopted it is planned that the sinking fund is to bear 4 per cent interest and the annual outlay, if adequate provision is made for sinking fund and interest to retire the bonds at the end of the twenty-fifth year, would be $8,721.26. Thus the difference in favor of the serial method would be $677.24 per annum, or a total of $16,931, and the debt would be liquidated within the same period of years under either plan.

The total expenditure from the bond fund to September 30, 1915, was $86,203.41, leaving a balance in the bond fund of $18,296.59, which was deposited in banks at an interest rate of 4 per cent. It seems that the county sold most of the bonds before the money was actually needed, and accordingly the unexpended balance cost the taxpayers nearly 2 per cent interest over and above the rate allowed by the banks. If the bonds had been sold as needed, a saving of some thousands of dollars possibly might have been effected.

As indicating the relation which the tax burden for roads and for the bond issues bears to the taxes for other purposes, the details are given in Table 10.

TABLE 10.—*Detail of tax rates, 1910 and 1915.*

Purpose.	Rates in cents per $100.	
	1910	1915
State tax	35	10
General county purposes	20	30
County schools	20	25
County roads	20	20
Road bonds		10
District schools	20	20
School bonds	5	5
Total	120	120

From this levy there was obtained in 1910 from the assessed valuation of $4,428,584 a total revenue of about $53,143, of which about $8,857, or 16.6 per cent, was for county roads. No tax was levied in that year for the road bonds. The 1915 levy on the taxable valuation of $5,985,140 produced $71,861.28 for all purposes, of which $11,970.28, or 16.6 per cent, was for county roads and $5,985.14, or 8.3 per cent, was for interest and sinking fund on road bonds. This amount was insufficient to pay the interest on the road bonds, amounting to $6,200, but the difference was made up by the 4 per cent obtained from the banks on cash balances of bonds sold. No provision has yet been made for the establishment of a sinking fund, and it must be evident that if the bonds are to be paid at maturity, such

provision should soon be made or else some relatively heavy taxes must be levied at no very distant date. If the necessary tax were levied from the outset only 15 cents on the hundred dollars would be required, but the longer this is delayed the greater the burden ultimately. While this county may make adequate provision in good time to care for its bonded indebtedness, the fact must not be overlooked that the sinking-fund method offers a temptation to keep putting off the day of reckoning, thus making necessary either the levying of heavy taxes at a time when the people have become accustomed to improved roads and a low rate, or, if the heavy taxes are not levied, the county must then face the necessity for refunding bonds. In this particular county the tax rate for the bonds was 15 cents on the hundred dollars in 1911, and the rate was reduced in 1912 to 10 cents and has remained at that figure since. The rate was cut down in order to provide revenue for a jail and for a steel index file without materially increasing the total rate for the county.

In connection with funds provided from the bond issues aid has been granted by the State in the form of convict labor, the State paying for guarding, clothing, feeding, and housing the convicts, while the county pays for their medical attention. One reason for the seemingly slow rate of expenditure of the bond issues by the county is the fact that all of the construction work is performed by the convict force, and the mileage completed each year is therefore limited by the constructive capacity of that force. From June, 1909, to September 30, 1915, the State had furnished 67,736.5 convict-labor days, which had cost the State an average of $0.5468 per day, or about $37,038.32. No money aid was granted by the State, as the State does not grant both convict and money aid to the same county during the same year. In measuring the results obtained for the given outlay it must be borne in mind that these results were not obtained by the bond issue alone, but that on the final showing the State will have paid nearly one-third of the cost, and, considering further that the convict labor is relatively cheaper than free labor, much of the credit for low cost of construction must go to the convict-labor plan rather than to other phases of the financing or management of the work.

HOW THE WORK WAS MANAGED.

The roads were built according to plans and specifications furnished by the State highway department and under the immediate direction of a superintendent selected by the State highway department and paid by the county from the bond-issue funds. The superintendent received a salary of from $75 to $100 per month, and reported both to the county road board, which has charge of all road work in the county, and to the State highway department. The road board con-

sists of 5 members, 1 from each district and 1 from the county at large. Previous to 1912 the members of this board were designated by the circuit court judge. Since that time the positions have been elective. The salary of the members is $40 per annum each, except the secretary, who receives $65 per annum. In addition to the salary members receive $2 per day for inspection, not to exceed $10 per annum for each district. The total salaries and expenses of the board are therefore about $265 per annum.

There were 102.5 miles of road designated for improvement in the order of election issued by the judge of the circuit court. Namozine district was to have 30 miles; Rowanty district, 22.5 miles; Sapony district, 23 miles; and Darvills district, 27 miles. The work was begun on June 16, 1909, and is still in progress. The county has 524 miles of public road, of which 91.31 miles have been surfaced from the bond-issue funds, which, added to the 9.75 miles previously constructed, make 101.06 miles, or 19.3 per cent of the total mileage surfaced. (Pl. VIII.) Of the 91.31 miles, 81.1 miles were constructed with the aid of State convicts and 10.2 miles without convicts. The 81.1 miles cost $68,490.72 in cash and 67,736.5 convict days. The cost of guarding, clothing, and food for convicts was paid by the State at an average of $0.5468 per convict working day, or a total of $37,038.32. The actual cost to the county was therefore $844 per mile, and, including convict labor, the average cost was $1,301.22 per mile. The total cost of the 10.2 miles built without convicts was $17,712.69, or an average of $1,736.53 per mile.

The roads were graded to an average width of 20 feet and were, for the most part, surfaced to a width of from 12 to 14 feet with top-soil, selected from near-by fields. The top-soil, which is a kind of natural sand-clay or gravel-clay mixture, consisted for the most part of clay naturally mixed with coarse sand or fine angular pebbles of disintegrated granite. This material is fairly well distributed throughout the county and in some cases was contributed free by abutting property owners. In other cases, however, it was purchased at 3 cents per cubic yard. Several sandy roads were treated with clay and several clay roads were treated with sand.

The county now has two surfaced roads radiating from Petersburg, extending entirely across the county. The Boydton Plank Road (Pl. VII, fig. 2, and Pl. X, fig. 2), 26.25 miles long, extends through the center of the county in a southwesterly direction along the Seaboard Air Line Railroad to the Brunswick County line. The Cox Road (Pl. IX, fig. 2), 32 miles long, extends through the northern part of the county in a westerly direction along the Norfolk & Western Railroad to the Nottoway County line. The Halifax Road has been improved for 3 miles south of Petersburg. The Stage Road has been improved for about 8 miles from the Nottoway River in a north-

easterly direction. The White Oak Road, about 15 miles of which has been improved, opens up the territory lying between the Cox Road and the Boydton Plank Road. This road is to be finished to the county line on the Nottoway River.

HOW THE ROADS ARE MAINTAINED.

The roads have not been systematically maintained, and while many sections are in excellent condition, other sections showed signs of wear and disintegration at the time of the 1915 inspection.

The condition of some of the roads before and after improvement is shown by the accompanying photographs. (Pls. VII and IX.) When the first inspection was made, during the latter part of March, 1910, the roads were practically impassable. The first year after construction the roads were more or less soft, but after the surplus clay had been leached out they became fairly hard and firm, even in wet weather.

The county road fund amounted to about $12,000 in 1915, of whic one-half is devoted to permanent work and one-half to maintenanc Six thousand dollars spread out over the whole mileage of the count amounts to only about $11 per mile for maintenance, which is entirel inadequate. This work is carried on under the general direction o the county road board and under the immediate direction of th county superintendent of roads. The maintenance work is done by three small gangs of 5 or 6 men each, and a total of 6 mules for the three gangs. These gangs are principally engaged in cleaning out ditches, dragging, and patch work.

EFFECT OF ROAD IMPROVEMENT ON LAND VALUES.

The following table shows the assessed valuation of real and personal property and public service corporations for 1905, 1910, and 1915, exclusive of Petersburg, which is not assessed for improvements outside of its corporate limits. Property is assessed at about one-third of its cash value. According to law it should be assessed at its "fair market value."

TABLE 11.—*Detail of assessed valuation 1905, 1910, and 1915.*

Year.	Real estate.	Personal property.	Mineral lands.	Public service corporations.	Total.
1905	$1,652,881	$484,829	.....	$1,091,523	$3,229,233
1910	2,071,249	757,955	$39,160	1,560,220	4,428,584
1915	2,855,343	[1] 1,063,820	.....	2,065,977	5,985,140

[1] Including tangible and intangible personal property and money as assessed under new tax law.

It will be seen from Table 11 that while the assessed values of real estate increased 25.3 per cent from 1905 to 1910, before the roads were improved, it increased 37.8 per cent from 1910 to 1915, the period which covers the improvement of the roads. In making the assessments for 1915 the assessors established a general rule of assessing all lands on the improved roads at a higher rate than those farther back; in fact, three zones were established on which land assessments were based. The first zone included all land abutting on or immediately contiguous to the improved roads; the second zone included all lands within easy hauling distance of the improved roads; and the third zone included all other land. The lands in the first zone were assessed at the highest rate, those in the second zone at about one-third less, and those in the third zone at about one-half of the first zone. By this arrangement those who own land on or near the improved roads and who receive the greatest benefit from them pay relatively more taxes than those who live on the unimproved roads.

That the increase in assessed value does not constitute a fictitious value, but an actual increase in value, is borne out by the records of sales. The actual value or selling price of land has greatly increased since 1909. This is attributed largely to the saving in cost of hauling and to the easier access of farms to markets and shipping points. The average value of 43 farms sold or offered for sale from 1909 to 1914 ranged from $8.38 to $43.74 per acre before the roads were built and from $24.70 to $73.60 per acre after the roads were improved. Our investigations brought out the fact that the farther away from town on the improved roads the land lies the greater the percentage of increase in value. Within 5 miles the percentage of increase was only 68.3; from 5 to 10 miles out the percentage of increase was 96.7, and from 10 to 24 miles out of Petersburg the percentage of increase averaged 194.9. Details regarding the 43 tracts above referred to are given in Table 12.

TABLE 12.—*Increase in land values.*

Number of cases considered.	Number of miles from Petersburg.	Old value per acre.	New value per acre.	Increase per acre.	Per cent of increase.
5	5 and less.	$43.74	$73.60	$29.86	68.3
22	5 to 10	15.25	30.00	14.75	96.7
16	10 to 24	8.38	24.70	16.32	194.9

EFFECT OF ROAD IMPROVEMENT ON TRAFFIC.

The dairy and truck industries were profitably carried on before the roads were improved for a distance of only about 3 miles out from Petersburg, the principal market town. Petersburg is located

in the northeastern corner of the county, and considering it as the center of a traffic area, bounded by a circle with a radius of approximately 3 miles and a total area of approximately 28 miles, the portion of the area in Dinwiddie County, comprising one-fourth of the total, would be about 7 square miles. After the roads were improved it was practicable to conduct dairy and truck industries for a distance of 6 or 7 miles from Petersburg, and thus the radius was lengthened to 7 miles and that portion of the traffic area located in Dinwiddie County was increased to a total of 38.4 square miles, or an increase over the original traffic area of 31.4 square miles.

In arriving at the total tonnage hauled on the improved roads, it was ascertained that about 232,000 bushels of peanuts are produced annually in the county, and about 70 per cent of the crop is hauled to Petersburg by wagon, an average distance of about 10 miles. There are also produced in the county about 3,368,000 pounds of tobacco a year, of which about 80 per cent is hauled to Petersburg by wagon, an average distance of about 15 miles. These two crops require considerable fertilizer, which is hauled from Petersburg to the farm. As an indication of the volume of traffic it may be mentioned that the Atlantic Coast Line Railroad at Petersburg handled outgoing shipments in 1911 amounting to 25,364 tons, and it is estimated that this railroad carried about one-third of the incoming and outgoing shipments at Petersburg. Not more than one-half of the incoming and outgoing shipments at this point, however, pass over the improved roads of Dinwiddie County, as the other half originates in or is consigned to Petersburg and to the adjacent counties of Chesterfield and Prince George. It is estimated that in addition to the traffic centering at Petersburg, about 60,000 tons of miscellaneous and forest products are hauled to way stations over the improved roads for an average distance of about 5 miles.

In order to obtain further data on which to estimate the total annual traffic passing over the bond-built roads to the market or shipping point at Petersburg, four traffic censuses were taken on the Halifax and Cox Roads, covering a period of one year. Practically all the hauling from Dinwiddie County to Petersburg concentrates on these two roads within 2 miles from town. The census on the Cox Road was obtained about $1\frac{3}{4}$ miles from Petersburg and on the Halifax road about 1 mile from Petersburg. The census periods included a week in March, a week in July, two weeks in December, 1914, and a week in April, 1915. The weekly census included Sundays, and the two weeks' census excluded Sundays. Table 13 is based on the results of these censuses.

TABLE 13.—*Traffic census.*

Name of road.	Average number of teams daily.	Average number of loads daily.	Average tons hauled per day.	Average tons hauled per year.	Average length of haul.[1]	Annual ton-miles.	Average of all motor vehicles daily.
Halifax	148	70	48.14	15,002.6	[2] 10	150,026	70
Cox	240	137	156.46	48,813.4	[2] 18.3	895,343	72
Totals for Cox and Halifax Roads	388	207	204.6	63,815.0	[2] 16.4	1,045,369	142

[1] Average haul includes unimproved roads. [2] Weighted average.

From Table 13 it will be seen that the total traffic on the Cox and Halifax Roads is estimated at 63,815 tons, that the average haul for the two roads is 16.4 miles, and that the average annual ton-miles is 1,045,369. With the 60,000 tons of miscellaneous and forest products hauled to way stations over bond-built roads an average distance of about 5 miles, or a total of 300,000 ton-miles, the estimated total traffic for the county is 1,345,369 ton-miles per annum. The traffic area for the improved roads includes about 80 per cent of the land area of the county, or about 266,752 acres. The tonnage produced and hauled over the roads, therefore, amounts to a little over one-fourth of a ton to the acre.

The average haul on the bond-built portion of the Halifax Road is 3 miles, which for 15,002 tons makes 45,006 ton-miles, and on the Cox Road about 10 miles, which for 48,813 tons makes 488,130 ton-miles. By adding the 300,000 ton-miles of forest and miscellaneous products hauled over the bond-built roads to local shipping stations, a grand total traffic for the bond-built roads of 833,136 ton-miles is secured.

In ascertaining the tonnage and ton-mileage for the improved roads, no computation was made of the motor traffic, except to count the number of motor vehicles, which averaged 142 per day, but it may be of interest to note in this connection that on a tonnage basis, assuming an average weight of 1.45 tons, and an average number of 51,830 motor vehicles passing over the roads in a year an average distance of 6.2 miles, the automobile traffic represents 75,155 tons, or 465,952 ton-miles, while in number of vehicles it would represent 27 per cent of the annual total of all vehicles.

ESTIMATED ANNUAL SAVING ON HAULING COST.

The average load for a double team on the old roads was about 2,000 pounds, and on the new roads about 3,200 pounds, although much larger loads were by no means uncommon. (Pl. X, fig. 1.) The average haul for a double team on the old roads was about 10 miles, and on the new roads about 12.5 miles. The average cost of

team and driver was about $3 per day. On this basis the cost of hauling per ton-mile on the old roads was approximately $0.30 and on the new roads $0.15. A saving of $0.15 per ton-mile on 833,136 annual ton-miles amounts to $124,970, which would be more than sufficient to retire the bonds in one year.

EFFECT OF ROAD IMPROVEMENT ON SCHOOLS.

One of the most important results attendant upon the improvement of the public roads in Dinwiddie County was the increase in attendance at the schools located on the improved roads. It was ascertained that during the school year 1912–13 the average attendance at 13 schools on the improved roads was 63.4 per cent of the total enrollment, and that the average attendance at all other rural schools in the county for the same year was 56 per cent. If the improved roads serve no other purpose than to equip with an adequate primary education 7 or 8 additional children each year out of each 100 enrolled the building of the roads would be justified.

Not only was the county school system affected through increased attendance, but also through the erection of larger school buildings (see Pl. XI, fig. 1) and the consolidation of small schools, while a particularly striking feature of the present school system is the transportation of the children to and from school. In 1914 several school wagons were in use, at an expense of about $306 per annum for the operation of each wagon with a capacity of 20 passengers. (See Pl. XI, fig. 2.) About one-eighth of the children who attend school at Petersburg live in the surrounding country districts, some of them as far as 6 or 8 miles from town.

LEE COUNTY, VA.

Road improvement began in Lee County in 1908 through the construction of a road between Jonesville and Ben Hur, a distance of 5.6 miles. This, the first improved road in the county, was completed in 1910. The work was carried on under the direction of a resident engineer from the State highway department, labor was performed by State convicts, and the funds were raised by private subscription. The average cost of the road was $4,203.68 per mile. Convict labor was furnished by the State to the extent of 10,035 convict working days, at a cost of 67 cents per day. The road was graded to a width of 30 feet, surfaced with macadam to a width of 12 feet, and a thickness of 6 to 7 inches consolidated.

The road served as a most successful object lesson to the people of the county, and the result was the voting of $364,000 of bonds on November 29, 1910, for the purpose of improving approximately 165.5 miles of road.

The county is located in the extreme southwestern corner of the State, at the eastern base of the Cumberland Mountains, and has an area of 433 square miles. The topography varies from gently rolling to mountainous. The county is well watered by mountain streams and the soil is very fertile. About half of the area of the county is in cultivation and produces good crops of wheat, oats, corn, rye, potatoes, sorghum cane, hay, fruits, etc. Much of the land formerly devoted to the production of grain has, in recent years, been converted into grazing land, and cattle are now fattened for export on the bluegrass pastures without grain feeding. There are several tracts of standing timber.

The population in 1910 was 23,840. There are no cities or large towns in the county, and the county seat, Jonesville, is 5.6 miles from Ben Hur, the nearest railroad station.

As the bonds were voted late in 1910, the economic studies were begun in March, 1911, and continued in March, 1912, May, 1913, and May, 1914.

HOW THE IMPROVEMENT WAS FINANCED.

The bonds were issued by districts as follows:

Rose Hill district	$65,000
Jonesville district	89,000
Rocky Station district	100,000
Yokum Station district	110,000
Total	364,000

As the bond election failed to carry in White Shoals district, no bonds were chargeable to that district. The bonds were dated January 2, 1911, carried 5½ per cent interest, and were sold at a premium of 2 per cent, which amounted to $7,280. The deferred serial method was followed, and the bonds were made payable as follows: January 1, 1916, $14,000; January 1, 1917, and thereafter to January 1, 1930, $15,000; January 1, 1931, to January 1, 1937, $20,000. An annual tax levy to pay interest on the bonds and retire $14,000 on January 1, 1916, should raise $114,100 during 1911 to 1915, inclusive, or an average of $22,820 per annum. Thereafter to pay interest and $15,000 each year there would be required an average of $28,887.50 per annum to January 1, 1930, and an average of $24,400 per annum after that date for seven annual payments of $20,000 each and interest. An examination of the steps already taken for the payment of interest and principal shows that the $14,000 due January 1, 1916, has been paid and that the present rate of taxation appears to be sufficient to pay interest and the annual payments on principal as they become due. In 1913 the rates for these purposes were 65 cents in Rose Hill, Rocky Station, and Yokum Station districts, and 75 cents in Jonesville district, and produced about $28,200.

In 1915 the rates were 75 cents in Rose Hill, 90 cents in Jonesville, 80 cents in Rocky Station, and 60 cents in Yokum Station, and produced about $37,000. This is about $10,000 per annum more than is needed for the first issue of $364,000, but will be required to pay interest and create a sinking fund for the $91,000 sinking-fund bonds subsequently issued.

While it is true, therefore, that the county adopted the most approved method of financing its road improvement so far as the first issue is concerned, it seems that it will have to carry a rather heavy tax burden. Applying this, however, to an individual case, it may be stated that a man owning a $5,000 farm assessed at $2,000, a fair example of the prevailing practice, would pay, on the basis of the 1915 rate of $1.96 for all purposes, State, county, and road bonds, a total of $39.20, of which 61 cents of the rate, or $12.20 total, would apply to the road bonds.

In 1913 additional 5 per cent bonds, to the extent of $60,000 for Rocky Station District and $16,000 for Rose Hill District, were issued on the sinking-fund basis, bearing interest at 5 per cent. In the fall of 1915 Rose Hill District issued $15,000 additional bonds. The sinking-fund method, as has been pointed out elsewhere in this bulletin, invariably proves more expensive than the serial method, except in those very rare cases where the sinking fund yields as large interest return as the interest payable on the bonds. The total of all bonds issued by the county was $455,000, which, with premiums, yielded a total of $464,560. This is the only bonded indebtedness of the county except $11,000 of short-term bonds for two high schools. A striking illustration of the disadvantage incident to the issuance of bonds by districts rather than by counties is brought out by the experience of Lee County. White Shoals District, in which no bonds were issued (see Pl. XIII), extends entirely across the county, separating the improved roads of Rose Hill District, located in the southwest corner of the county, from the improved roads in the other parts of the county, thus imposing considerable inconvenience on other neighborhoods of the county, whereas if the county as a whole were handling the project the improvement could be systematically conducted. It is explained that the opposition in White Shoals District to the voting of bonds is due to the fact that convicts are not yet available for work in that district and that as soon as such aid is available the district will probably take up the work.

A comparison of taxation between the years 1910 and 1915 reveals the fact that while the total tax rate for all county purposes in 1910 averaged $1.05, or, including the State tax, $1.40, the rate had increased in 1915 to an average of $1.86 for all county purposes and $1.96 for all county and State purposes, a total tax-rate increase of 40 per cent, while the 61-cent average for road bonds was an entirely

new item in 1915. The county roads, the district roads, and the road bonds jointly required $1.11, or 59.7 per cent of the county rate, or 56.6 per cent of the total for all purposes. This average rate for road bonds is somewhat misleading, as the individual rates range from a minimum of 60 cents in Yokum District to a maximum of 90 cents for Jonesville District. It may convey a more accurate conception of the situation, therefore, if the statement is made that the taxpayer in Jonesville District pays a total of $2.25 on the hundred dollars of valuation for all purposes, of which 40 per cent is for the road bonds, this being the highest tax rate in the county. The reduction in the State tax for 1915 to 10 cents is partially offset by other forms of State tax on railroads, on cash in banks, on notes, bonds, and certain other intangible property. There was obtained from the assessed valuation of $4,689,205 in 1910 about $65,600, while from the assessed valuation of $4,973,457 in 1915 there was obtained about $97,500. Thus in spite of the improvement in the roads very little increase in the assessed valuation took place, and only by a marked increase of the tax rate was it possible to produce adequate revenue. This county, therefore, affords a striking exception to the general rule that improved roads bring about increase in assessed valuations.

HOW THE WORK WAS MANAGED.

The routes were selected and the number of miles to be improved and the amount to be expended determined without first obtaining engineering inspection and advice. This may account for the fact that the mileage of roads set forth in the order of election was greater than could be improved with the funds derived from the bond issue. This discrepancy between promise and fulfillment caused a considerable amount of dissatisfaction, and the experience of this county demonstrates the necessity for obtaining competent engineering advice before launching upon extensive road improvement. As pointed out elsewhere in this bulletin, legislation has recently been enacted in Virginia requiring inspection and preliminary estimates by the State highway department before bond elections can be held.

The general scheme of improvement was to construct two main roads extending through the county, with branch roads from the farming communities, but as White Shoals District failed to vote in favor of the bonds it was not possible to carry out the plan for two main roads. Less than 60 per cent of the roads originally provided for in the order of election have been improved. One road 20 miles in length, from Rose Hill to Cumberland Gap, and another road 8 miles in length, from Ben Hur to St. Charles, have been graded and macadamized. Three other roads, aggregating 22½ miles in length, have been graded. A number of short sections in various parts of

the county have been improved by grading or have been graded and macadamized. Several of these short sections do not connect with other improved roads, and this fact, together with the failure of White Shoals District to vote the bonds, gives the county a rather disconnected system of roads, as shown by the map (Pl. XIII). Examples of contrasts on the Powells Valley roads are shown in Plate XV.

The roads were constructed according to plans and specifications furnished by the State highway department, and this work, as well as the supervision and inspection of construction, was performed by a county engineer selected by the State highway department. His salary of $2,000, however, was paid by the county out of the funds derived from the bond issues. All contracts were let by the State highway department and the county board of supervisors, acting jointly.

The board of supervisors consists of five members—one for each district. They are selected by the people for terms of 4 years, and receive $4 per diem for time actually employed, not to exceed 20 days per annum. There is one road superintendent in each district, appointed by the board of county supervisors. The road superintendents have charge of repairs and maintenance, and receive about $100 per annum each. In the case of new construction, special superintendents are appointed, and receive from $2.50 to $3 per day.

According to information obtained from the State highway department, it is estimated that there are about 450 miles of road in the county, of which 39.26 miles, or 8.7 per cent, were graded and macadamized under the bond issue to October 1, 1915. In addition to this there were 60.19 miles graded but not macadamized, making a total of 99.45 miles, or about 22 per cent, graded and partly macadamized under the bond issue, with State aid in certain cases in the form of convict labor. Of the total mileage improved, 69.70 miles were constructed entirely out of bond-issue funds, but under the plan of State aid in effect in Virginia the county will ultimately be reimbursed to the extent of one-half of the cost of these roads. In building 29.75 miles, a total of 39,953.75 convict-labor days were contributed by the State at an average cost of 53 cents per day, or a total of $21,175.48. The cash expenditure by the county on these roads was $75,149.24, thus making the average cost of the convict-built roads $3,237.79 per mile. Of the roads built with free labor, 16.63 miles were macadamized, and of the roads built with convict labor 22.63 miles were macadamized, but unfortunately no segregation is available of detailed cost of the macadamized roads and those which were merely graded. However, as an indication of these relative costs, it was ascertained that 10.5 miles graded and mac-

adamized under the money-aid plan cost an average of $6,303.52 per mile, and that 47.25 miles graded but not macadamized cost $3,248.83 per mile. On this basis the grading cost about 52 per cent and the macadam about 48 per cent. The transformation wrought by the new construction is strikingly shown in Plates XII and XIV.

HOW THE ROADS ARE MAINTAINED.

The improved roads of Lee County are not systematically maintained, and they are beginning to show signs of wear. A little work is done now and then in cleaning out ditches and opening up culverts under the direction of the district road superintendents. A 3-mile section of the road from Ben Hur to Jonesville was resurfaced in 1914 at a cost of $2,500, paid from the bond-issue fund. This road was scarified and resurfaced with No. 2 stone and screenings, sprinkled and rolled down, and is now in very good condition. The balance of the road is badly worn and should be resurfaced as soon as possible. This is the only extensive repair work that has been done.

EFFECT OF ROAD IMPROVEMENT ON LAND VALUES.

Since changes in assessed valuation between 1910 and 1915, as pointed out elsewhere in this chapter, have been comparatively slight, it would appear, if such a standard indication were accepted, that the improved roads have not produced greater property values in the county. Personal inspection and inquiry in 1911, however, relating to 32 distinct farms, indicated an average value on the roads selected for improvement of $40 per acre, while the lands along the cross-country roads averaged about $25 per acre. Lands along the Ben Hur-Jonesville road, the only one improved up to that time, averaged about $100 per acre, and it was ascertained that the average before the improvement was about $25 to $35 per acre.

In the 1913 study it was found that the average value of seven tracts of land selected at random on the improved roads, containing a total of 1,289 acres, was $75 per acre, showing an increase in the two years preceding of about 80 per cent. One case deserves special mention as illustrating the effect of road improvement on land values. A tract containing 109 acres on the road between Ben Hur and Jonesville was sold before that road was improved for $4,500, but the purchaser failed to take the land, claiming that the price was exorbitant. This same land sold in 1911, after the road was finished, for $9,000, a gain of 100 per cent over the supposed exorbitant price.

TABLE 14.—*Values or sale price per acre.*

1911, before improvement.	1912, after improvement.	1911, before improvement.	1912, after improvement.
$50	$80	$30	$40
50	80	30	40
20	42	40	75
30	50		
20	40	Av. 33	56

Table 14 shows the approximate land values of eight tracts in the Powell Valley along the roads before and after improvement and that these properties increased about $23 per acre, or about 70 per cent. If all of the improved farm land in the county within one-half mile of the improved roads increased in value at the same rate as the Powell Valley lands above referred to, the total increase would amount to $860,940.

The foregoing examples, showing that there has been a decided increase in the value of lands along the improved roads, are in conflict with the record of assessed valuation.

EFFECT OF ROAD IMPROVEMENT ON TRAFFIC.

This county has an excellent home market at the various mining camps in the northern section of the county and in the adjacent county of Wise, but does not begin to supply the demands of those markets.

The traffic on the road connecting Jonesville, the county seat, with Ben Hur, its railroad point, is about the heaviest in the county, and represents about nine-tenths of the total freight receipts for shipment over the Louisville & Nashville Railroad at Ben Hur. It consists principally of coal and supplies hauled from the railroad station, and timber and other forest products hauled to the station for shipment.

The Tri-State Road, which extends from Cumberland Gap toward Jonesville through Rose Hill, also has considerable traffic. The hauling consists principally of foodstuffs from farms in the fertile Powell Valley to the market in Cumberland Gap and Middlesboro, Ky. The macadamizing of this road has opened up a large area of the Powell Valley to the market in Middlesboro. Since this road was completed there has been an increase of 25 per cent in the number of buggies sold by the wagon factory in Cumberland Gap and automobiles are being introduced into this section, which shows that the people are finding the improved roads of social as well as commercial benefit.

The road which connects Pennington Gap, the principal town of the county, with the mining section at St. Charles is another one of the principally traveled roads. Since the improvement several

hucksters in the county have established regular routes through the farming sections and buy up chickens, eggs, butter, and other products. These products are sold in the mining camps or hauled to the railroad stations. In this way the farmers receive cash for many perishable products which would otherwise be a total loss.

The improvement of the roads has brought about the shipment of large quantities of tanbark, extract wood, and pulp wood hitherto unprofitable. The teamsters in hauling lumber to Jonesville over 4 and 5 miles of earth roads, then on to Ben Hur over the macadam road, can only haul a small load into Jonesville, return for a second load, to which the first is added on reaching Jonesville, and then haul both in one load over the improved road to Ben Hur. In hauling coal from Ben Hur, two wagons are fastened together and drawn by one team to the end of the improved road, then uncoupled and hauled separately to their destination over the earth roads.

There are 97 miles of railroad in the county, and as a basis for ascertaining the tonnage hauled over the public roads, the freight shipments on the Louisville & Nashville Railroad at 11 stations in the county were ascertained in 1914 to be 49,733.23 tons of outgoing freight and 16,211.37 tons of incoming freight, exclusive of coal and iron ore, which do not pass over the public roads. From the data thus obtained and from a study of the traffic areas served by the roads, supplemented by actual observations of traffic, it has been estimated that the annual traffic, not including live stock, on the roads of the county in 1914 was as shown in Table 15.

TABLE 15.

	Tons.
Forest products	28,000
Farm and miscellaneous products hauled to the railroad station and mining districts	25,565
Feed, fertilizer, coal, groceries, and miscellaneous products	20,630
Total	74,295

Of the total tonnage it is estimated that approximately 80 per cent, or 59,436 tons, are hauled over the improved roads an average distance of 5 miles, thus making the total annual ton-mileage on the improved road system 297,180 ton-miles.

From numerous observations made in 1911, it was found that the average load for a two-horse team before the roads were improved was about 2,000 pounds in the summer and fall and about 800 to 1,000 pounds during the winter and spring, with an average throughout the year of about 1,500 pounds. Most of the hauling was done in the fall, so as to avoid bad roads during the winter and spring.

As compared with the average load on the old road of 1,500 pounds, the average on the improved road is about 4,000 pounds. The value

of a two-horse team and driver has increased from $3 to $3.50 per day in the past few years, due to the increased cost of feed.

Lumber is hauled into Pennington Gap 7 miles along the Dryden Road, 700 feet b. m. to the load. This road is now graded and about 1 mile macadamized. Two trips a day are now made by teamsters, who receive $3 per 1,000 feet b. m., which is at the rate of 17 cents per ton-mile.

Hauling costs on the old roads varied all the way from 40 to 80 cents per ton-mile. The average cost per ton-mile for the cases under observation was 25 cents on macadam, 40 cents on graded roads, and 55 cents on the old roads. The saving is 30 cents on macadam and 15 cents on graded roads, and an average of about 20 cents per ton-mile. The total annual saving by reason of the improved roads would, therefore, be about $59,400.

An implement dealer at Jonesville reports that he gave $400 toward the building of the Ben Hur-Jonesville road four years ago and that he is now saving that amount each year by the reduced cost of hauling freight from Ben Hur. He paid for hauling freight from 15 to 20 cents per hundredweight for a 5-mile haul over the old road, which equals from 60 to 80 cents per ton-mile; on the improved road, from 8 to 10 cents per hundredweight for a 5-mile haul, which equals from 32 to 40 cents per ton-mile. For hauling coal, 10 cents per bushel of 80 pounds for a 5-mile haul on the old road, which equals 50 cents per ton-mile; on the improved road he paid 5 cents per bushel of 80 pounds for a 5-mile haul, which equals 25 cents per ton-mile

WISE COUNTY, VA.

Road improvement in Wise County was begun in 1910 through the construction of 4.6 miles of macadam road under the supervision the State highway department. As was the case in other counties, the first example of good-road construction served as an object lesson and created a strong sentiment for comprehensive road improvement throughout the county. On November 22, 1910, a county bond issue of $700,000 for grading and macadamizing 110 miles of road was carried by a vote of 2,156 for the bonds to 176 against them. Unfortunately, no preliminary surveys or engineering advice were obtained upon which to base the program of construction outlined in the order of election, and in consequence it was found, after the bonds had been voted and surveys for actual construction made, that the routes set forth in the order of election aggregated 125 miles instead of 110 miles, and that the cost of grading and macadamizing this mileage would amount to more than $1,000,000 instead of the $700,000 which the people had voted. This naturally caused some dissatisfaction and required a change in policy. It was, therefore, decided to grade the whole mileage and build permanent drainage structures, utilizing

what was left of the bond issue to macadamize the most important roads.

Following the first bond issue, two of the districts, Gladesville and Richmond, voted $130,000 each in order to macadamize the roads which had been graded and to build a few additional miles.

The economic conditions in Wise County are rather exceptional, as the chief industry is coal mining; and the mineral lands, coal and iron, constitute about half of the assessed valuation of the county. There are 34 coal-mining plants, employing in the aggregate about 9,000 men. Agriculture is not extensively practiced, and the products, which are principally corn, oats, hay, potatoes, and sorghum cane, are small in volume. Some orchard fruits are produced, and dairying and poultry raising are engaged in on a small scale. The county is well supplied with railroads, and as its principal output is from the mines, comparatively little tonnage is hauled over the public roads. The county, which has an area of 420 square miles, is quite mountainous, and the soil is not productive, except at the bottom of the narrow valleys along the streams. This rough topography causes road construction to be very expensive, on account of heavy grading. (See Pl. XVIII.) Moreover, a large portion of the surfacing material must be transported by rail or by long wagon haul. The mining interests are paying the larger part of the costs of the road system, and in judging of the returns to the county from an economic standpoint it should be borne in mind that while the value of the road system to agriculture is slight, the corresponding burden upon agricultural property, by reason of the help of the mining interests, is also comparatively light.

The economic studies in Wise County were made during the months of March, 1911, March, 1912, May, 1913, May, 1914, and a short study in October, 1915.

HOW THE IMPROVEMENT WAS FINANCED.

The issue of county bonds dated February 1, 1911, brought a premium of 2 per cent, while the two district bond issues dated March 1, 1913, were sold at par. Thus the total amount realized from the bond issues was $974,000.

All the bonds bear interest at the rate of 5 per cent, and are issued for 30 years with options to retire at the end of 20 years. The law provides that a levy of not to exceed 90 cents on the hundred dollars shall be assessed for the purpose of paying interest and creating a sinking fund to retire the bonds. The present tax for this purpose is 45 cents for the $700,000 county bond issue and 20 and 25 cents, respectively, for the district bonds in Richmond and Gladesville districts.

The board of county supervisors is authorized to create a sinking fund and to apply any part or all to the purchase of any of the bonds at any time. The county board is further authorized to lend upon real estate security, the loan not to exceed 50 per cent of the assessed value of such real estate, or deposit in bank at interest all accumulations of money to the credit of the sinking fund. No sinking funds have been so invested, as it is difficult to lend money on real estate on a 50 per cent assessment basis, and for that reason the board of supervisors expect to purchase and retire the bonds as fast as money accumulates in the sinking fund, provided the bonds are on the market at a price which would be advantageous to the county. This method would be somewhat similar to the deferred serial method.

It must be borne in mind, however, that the holders of the bonds might, up to the twentieth year, refuse to surrender them, and would thus force the sinking-fund method upon the county. This element of uncertainty is the weakness of the retirement method as contrasted with a regular deferred serial method.

On the basis of the 1915 assessment of $13,500,000, the $700,000 of county bonds could be paid off in 25 years by an average tax rate of 36.7 cents per hundred dollars to be devoted to payment of interest and retiring the bonds annually, and the total amount paid out would be about $1,241,500 if $35,000 of the bonds are purchased at par each year after the fifth year instead of establishing a sinking fund. Under the sinking-fund plan, with sinking fund bearing 3 per cent and running 25 years, the total cost would be $1,354,988, or an average of $54,199 per annum for interest and retirement. The total saving by paying off the bonds instead of accumulating sinking fund would be $113,488. The tax rate for the sinking-fund plan would be 40 cents on the present valuation as compared with 35.7 cents for the deferred serial plan, or for buying up the bonds at par.

If the total bond issue of $960,000 were retired the twenty-fifth year on the sinking-fund plan, with interest on sinking fund at 3 per cent, the total cost would be $1,858,269. If the serial plan were adopted with the first payment, beginning on the sixth year, and the last payment the twenty-fifth year, the total cost would be $1,704,000, thus showing a total saving by the deferred serial plan of $154,269, as compared with the sinking-fund plan. Even if 4 per cent could be realized on the sinking fund, there would still be a saving of $72,288.

The tax levies are fixed annually by the county board of supervisors, and in order to provide for the county bond issue the board levied a tax of 30 cents on the hundred dollars in 1910, but even with this additional burden the tax rate for local purposes was only 10 cents higher in 1910 than in 1905, as there was a reduction of 5 cents in the tax for general county purposes and a total elimination of the tax of 15 cents for district roads. Thus the total tax burdens

were $1.30 in 1905 and $1.40 in 1910. In 1915, however, the tax rate had risen very materially, as the total tax averaged $1.65, in addition to which a district tax was levied in Richmond and Gladesville districts of 20 and 25 cents, respectively, for road bonds, so that in those two districts taxpayers were paying a total rate for all purposes, State, county, and district, of $1.80 and $1.90, respectively, of which the road bonds, the county roads, the district roads, and the district road bonds taxes formed 55.5 and 57.8 per cent, respectively. It is thus evident that the good roads carried with them a material tax burden. Although about 65 per cent of the taxes are paid by the public service and mining corporations, these organizations were in favor of the bond issues for road improvement. It seems quite probable that the highest point of taxation has, however, already been reached and that a slight reduction may be expected in the future. The 10-cent special county road levy for 1915 was to apply to the payment of an excess of about $57,000 in the cost of the roads over and above the amount obtained from the bond issue. A 20-cent tax was levied for this purpose in 1914, and it is expected that this 1915 levy will be sufficient to retire all of the floating debts. Averaging the rates for all purposes over the entire county, it appears that while the average rate increased 25.7 per cent from 1910 to 1915 the receipts from taxation increased 55.3 per cent, or from a total of about $154,600 in 1910 to a total of about $240,100 in 1915. The road bonds required 33.8 per cent of all the receipts for local purposes in 1915.

AID GRANTED BY STATE.

Under the Virginia law the State pays one-half of the cost of all State-aid roads and provides that if the county issues bonds and pays more than 50 per cent of the cost it shall be entitled to receive an annual apportionment until the receipts from the State shall equal 50 per cent of the cost of improvements. Wise County is, therefore, entitled to receive from the State one-half of the money expended on this work, which half amounts to $515,789. From 1910 to 1915, inclusive, the county received from the State $40,904.

The State money aid is derived from an annual appropriation made by the General Assembly of Virginia and apportioned among the various counties on the basis of taxes paid by the counties to the State. The automobile-license money is derived from the State automobile-license fund and is apportioned among the various counties in the same manner as the State-aid money.[1]

The funds derived from these sources may be used toward paying interest or retiring the bonds, for maintenance, or for construction

[1] An act passed in 1916 by the legislature provides for the use of the automobile funds for maintenance of State-aid roads.

of new roads. It is the present practice and intention of the county authorities to use it for the building of new roads and in the maintenance of roads already constructed.

HOW THE WORK WAS MANAGED.

From July, 1911, when the first contracts were let, to September 30, 1915, a total of $1,031,578.54 was expended in the construction of the improved roads. With this amount 144.52 miles of road were graded, of which 78.47 miles were macadamized. Of the macadam roads, 24.34 miles were surfaced with bituminous material. There were also constructed 30 steel bridges and 95 concrete culverts. Of the first bond issue of $700,000, about 76 per cent was spent for grading, 3 per cent for bridges, and 21 per cent for macadamizing. Nearly all of the two district bond issues, aggregating $260,000, was spent for macadamizing roads previously graded. The cost of surface treatment of 24.34 miles of macadam roads amounted to $9,758.82, or $400.93 per mile. The roads were graded to a width of from 16 to 18 feet, while the macadam surface varied from 9 to 12 feet. A good contrast between the old and the new roads is shown in Plate XVI.

It is estimated that there are about 300 miles of public road in the county, of which 83.07 miles, or 27.6 per cent, have been macadamized. (See Plate XVII.) This includes 4.6 miles of State-aid macadam. In addition to this, 66.05 miles have been graded under the bond issue and 1.3 miles with local funds, making a total of 150.42 miles, or 48.6 per cent of the total, partially or wholly improved.

The State highway department furnished plans, specifications, and estimates for the roads and supervised the actual construction, but, as has been pointed out in connection with other county studies, the State highway department was not called in to make any examination and estimate before the bonds were voted, and this absence of competent advice was decidedly injurious to the county. The immediate supervision of the work was intrusted to a county engineer appointed by the board of supervisors with the approval of the State highway department. His salary of $175 to $200 per month was paid by the county out of the bond-issue funds.

The roads were built by contract awarded by the State highway commission and the county board of supervisors under the unit-price system, with the exception of some macadam surfacing under the district bond issues where the work was done by force account.

The regular road work of the county is carried on by the district road superintendents, under the general direction of the county board of supervisors. The board consists of four members—one for each district. They are elected by the people for 4-year terms and receive $4 per day for time actually employed, not to exceed

30 days per annum. The district road superintendents, one for each district, are appointed by the board of county supervisors for terms of 2 years and receive $3.50 per day for time actually employed. There are no toll roads.

HOW THE ROADS ARE MAINTAINED.

Very little has been done previous to the present season toward the maintenance of the roads improved, except to keep ditches and culverts open. The roads were beginning to show signs of wear and, in 1915, 24 miles were surface-treated with bituminous material and stone chips at a cost of about $400 per mile, paid from bond-issue funds. About one-half gallon of bituminous material and 21 pounds of screenings were used to the square yard. The roads which were treated are the most heavily traveled roads of the county. This work was done by the district superintendents under the general direction of the board of county supervisors.

The use of bond issue funds for maintenance is exceedingly unwise as the debt outlives the temporary improvement by many years.

EFFECT OF ROAD IMPROVEMENT ON LAND VALUES.

A comparison of assessed valuations brings out the fact that in 1910, the year in which the bonds were voted, the assessed valuation was $11,011,788 and that in 1915 it had increased to $13,629,383, a gain of $2,617,595, or 23.7 per cent. The mineral lands, which formed 43.6 per cent of the total value of all property in 1915, showed a decrease of 4 per cent in value, as some lands which were assessed as mineral lands in 1910 were assessed as nonmineral lands in 1915, and furthermore, the building of the improved roads would naturally have a comparatively slight effect upon the value of mineral lands, as the operation of the mines depends more upon railroad than public-road facilities. The nonmineral lands, however, increased nearly 31 per cent from 1910 to 1915. It is difficult to gauge the increase in actual values by assessed valuation figures, as the relation between assessed value and actual value varies from 20 to 90 per cent, and probably averages about 60 per cent of the actual value.

Personal investigation, however, as to sale values brought out some convincing evidence as to the effect of the improved roads upon sale values. Of the large number of individual cases considered, eight, selected as fairly representative, are presented in this chapter. The value of these eight farms located on improved roads in various parts of the county increased 61.9 per cent, or from an average of $49.06 per acre before the roads were improved to $79.44 after the roads were improved, and it is commonly accepted in the county that the increased value was due almost entirely to the road improvement.

A farm near Big Stone Gap, containing 100 acres, was valued in 1910 at $70 an acre and in 1913 at $100 per acre.

A farm 1 mile east of Coeburn, containing 100 acres, was valued at $60 per acre in 1910, before the road was improved, and in 1913 at $90 per acre.

A portion of a farm between Big Stone Gap and Minton, containing 30 acres, was sold in 1914, after the road was improved, for $50 per acre. This whole farm was purchased in 1908 for $10 per acre.

A tract between Coeburn and Norton, containing 12 acres, was purchased in 1910 for $33 per acre, and was sold by the purchaser in 1914 for $150 per acre.

A portion of a farm on the road from Wise to the Dickenson County line originally contained 80 acres, valued in 1911 at $30 per acre, and was sold in 1912 for $50 per acre.

On the same road, 35 of the 160 acres of a farm, valued at $30 per acre in 1911, sold in 1912 for $40 per acre.

A farm between Norton and Wise, containing 30 acres, was valued at $25 per acre in 1911, and was sold in 1914 for $33 per acre.

Another tract located on an improved road, and containing 100 acres, one-half of which is cultivated in grain and fruit, was valued at $60 per acre in 1910, and had increased in value to $100 per acre in 1913.

EFFECT OF ROAD IMPROVEMENT ON TRAFFIC.

As the principal exports of the county are coal and coke, for the transportation of which there is an exceptionally large railroad mileage in the county, the traffic conditions from the public-roads standpoint are not especially striking. The county does not raise enough vegetables for its own consumption, and probably 75 per cent of all the green truck used in the towns and mining camps is shipped in from outside the county. Not over 60,000 acres in the entire county are devoted to agricultural purposes. As nearly as can be ascertained, the tonnage hauled over the improved roads in 1915 was as shown in Table 16.

TABLE 16.

	Tons.
Farm products	10,000
Forest products	32,000
Fuel	4,000
Fertilizers, groceries, etc	4,000
Total	50,000

The tonnage of farm products amounts to about 0.16 ton per acre for the 60,000 acres devoted to agriculture.

Based upon information secured from drivers of teams, it was found that the average load on the roads before improvement was

1,500 pounds, with an average haul of 4 miles. Estimating cost of driver and 2-horse team at $3.50 per day, and that two trips were made per day, it follows that the cost per ton-mile was 57 cents. After the roads were improved, the average load for the whole improved road system, comprising not only macadam roads, but graded earth roads as well, was 2,500 pounds. This increase in load serves to decrease the hauling cost to 35 cents per ton-mile, but on the improved roads it is possible for a 2-horse team to make three trips of 4 miles each per day, which still further reduces the cost to about 23 cents per ton mile, a saving of 34 cents per ton mile, which, applied to the entire 200,000 ton-miles, would aggregate $68,000 per annum. This computation is not intended to represent an actual saving of that amount of money to the people of the county, but is rather intended to afford a basis for estimating the loss of time and energy on the old roads. As indicating the individual benefits of lowered hauling costs, one teamster found that he would save $1,500 in hauling 800,000 feet of lumber, as he would be able to haul 1,200 feet with each two-horse team on the new roads as compared with 800 feet on the old roads.

EFFECT OF ROAD IMPROVEMENT ON SCHOOLS AND SOCIAL CONDITIONS.

The principal advantage of the improved roads has so far been to facilitate travel from point to point and to better school and social conditions. (See Pl. XIX.) The postmaster at Big Stone Gap is authority for the statement that every family on his rural delivery routes has either built a new home or improved the old one since the roads were finished. The sanitary conditions in the country districts have improved, and many conveniences and comforts are now provided in farm homes which would have been considered luxuries when these homes were partly isolated by the bad roads.

The following information showing the relation of improved roads to the schools was furnished by James N. Hillman, the superintendent of schools of Wise County:

> At least 40 per cent of the school population is in what is classed as strictly rural communities. Here the average daily attendance, as well as the enrollment, has increased by leaps and bounds since the building of our roads. For example, the enrollment for the year ending June 30, 1915, was more than 1,000 increase for the year over any preceding year. The average daily attendance increased 700, the greatest in the history of the county.
>
> The past month (September, 1915), we enrolled in round numbers 9,000 pupils, out of a total school population of 11,000, and had an average daily attendance of more than 8,000, or about 90 per cent. This is the greatest in the history of the county, as the yearly average attendance heretofore has been between 60 and 70 per cent. I might add that we have a form of compulsory attendance in effect this year, which, no doubt, is responsible for some of the unusual increase in daily attendance.
>
> We confidently expect our enrollment to reach 10,000 during the year. We also expect to see the average attendance close to 8,000.

Schools that had to close by reason of failure in attendance previous to the building of good roads now assist in supporting good consolidated schools, at which the attendance is splendid.

The 4-room school known as Maple Grove, in the Hurricane District, is one of these. It supplants three 1-room schools, each of which, without exception almost, failed every year to keep up its average. At present there are but two teachers in the consolidated school, but they have an enrollment of 64, with an attendance last month (September, 1915), of 59.

The Duncan Gap School, a 2-room building, supplanting two 1-room schools, is doing well, and would not have been possible but for good roads, in my opinion.

The above schools are in the heart of the *country*.

The percentage of population enrolled has increased from about 70 per cent during our bad roads to at least 90 per cent for the last year, before compulsory attendance was enforced, and will be better than that this year, I have no doubt.

It might be well to add, also, that a number of parents who own automobiles and who live in the country districts are now bringing their children into larger towns, that they may have the benefit of a strictly graded, well-manned high school. Before our good roads this was, of course, absolutely impossible.

FRANKLIN COUNTY, N. Y.

In 1910 Franklin County authorized the issue of $500,000 in bonds with which to improve certain important roads designated as county roads. The county is located in the northeastern part of the State, extending from the St. Lawrence River to well within the Adirondack Mountains and comprising a land area of 1,678 square miles, or 1,073,920 acres, of which, in 1910, 18.6 per cent, or 199,824 acres, was improved farm land. The topography varies from comparatively level in the north to rolling in the central portion and mountainous in the south, with an average elevation above sea level of 155 feet in the north, 800 feet in the central portion, and 1,600 feet in the southern portion. Small rivers and creeks are numerous. The soil varies from dark vegetable clay loam to light sandy loam. During the winter snow generally covers the ground for a period of 3 to 4 months. The snow roads, when rolled or packed down, are very good, and loads weighing 2 tons or more are readily drawn with 2 horses. A large proportion of the forest products which pass over the public roads are hauled on sleds during the winter months.

The county is well provided with road-building material. There are numerous outcroppings of Adirondack gneiss in the southern part, of granite and sandstone in the central, and of dolomite and limestone in the northern part. Glacial deposits of granite and sandstone bowlders and gravel are everywhere abundant and of excellent quality for road-building purposes.

There are no large cities within the county or in the immediate environment. Malone, the county seat and principal town, had a population in 1910 of 6,447. The population of the entire county was 45,717 in 1910.

The principal industries are dairying and lumbering. The chief crops are potatoes, hay, hops, barley, and corn fodder for silage. A considerable amount of maple sugar is also produced. Most of the milk and cream in Franklin County is hauled from the farms by the dairy companies.

SUMMER RESORTS AND TOURIST TRAVEL.

The southern half of Franklin County is in the heart of the Adirondacks and there are hundreds of beautiful lakes surrounded by camps, cottages, villas, and hotels. During the calendar year 1912 there were 371 automobiles registered in the county, of which 11 were commercial vehicles. During 1914 the registrations had increased to 823 pleasure cars and 30 commercial vehicles. This does not, however, represent the total number of motor vehicles using the roads of Franklin County, as the Adirondacks region is visited every summer and fall by thousands of tourists from all parts of the country.

The various hotels and summer resorts afford excellent markets for fruits, vegetables, poultry, and dairy products. There are no canning factories in the county, and as the soil and climatic conditions are well adapted to the growth of fruits and vegetables, it is believed that when all the main roads are improved there will be a good opportunity for developing this industry.

Three inspection trips were made through the county on the following dates: May, 1912, May, 1913, and May–June, 1914.

HIGHWAY CLASSIFICATION AND MAINTENANCE.

The roads selected for improvement under the bond issue by the county board of supervisors have an aggregate length of 135 miles, and in connection with the State and county highways will form a system connecting the principal towns, market centers, and summer resorts of the county. The total public-road mileage of the county aggregates 1,370 miles, of which 145 miles, designated as State and county highways, are being improved under the supervision of the State highway department. About 212 miles of town roads have been surfaced, so that when the contemplated work is completed the surfaced roads of the county will comprise 492 miles, or about 36 per cent of the total mileage. (See Pl. XXII.)

The roads, as planned at the time of the last inspection, are divided into four classes, and are paid for and maintained as follows:

State highways.—Seventy-five miles. Paid for wholly by the State from the $100,000,000 bond issue. Maintained by State, under patrol-and-gang system, but towns contribute $50 per mile per annum. Patrolmen receive $3 per day and furnish their own teams.

County highways.—Seventy miles. Paid for partly by the State, partly by the county. The amount paid by the county is deter-

mined by taking 2 per cent of each thousand dollars of assessed valuation per mile of public road. The county's share shall in no case exceed 35 per cent of the cost of the improvement. County highways are maintained by the State in same manner as State highways, the towns paying $50 per mile per annum.

County roads.—One hundred and thirty-four and six-tenths miles. Paid for entirely by the county, exclusive of the towns. The county roads are the ones which are built from the county bond issue. They are maintained by county, by day labor under patrol-and-gang system (see Pl. XXIV) the State paying 50 per cent.

Town highways.—One thousand and ninety and four-tenths (1,090.4) miles. Paid for partly by the State and partly by the towns under what is known as "the money system." The amount received from the State varies with the amount of taxes levied per mile of road, as follows: Where the assessed valuation of property, exclusive of cities and villages, is less than $5,000 per mile of road, the town receives $1 from the State for every $1 locally raised. Where the assessment is over $5,000 and less than $7,000, the State pays an amount equal to 90 per cent of the taxes so raised; over $7,000 and less than $9,000, the State pays 80 per cent; over $9,000 and less than $11,000, 70 per cent; over $11,000 and less than $13,000, 60 per cent; and when the assessment exceeds $13,000, the State pays 50 per cent. Town highways are maintained by towns. The cost of maintenance is borne in the same manner as for construction.

HOW THE IMPROVEMENT WAS FINANCED.

The $500,000 bond issue was authorized by the board of county supervisors in 1910, and the enabling act was passed by the legislature in 1911. The bonds are issued at the discretion of the county highway commission. One hundred thousand dollars of bonds were issued in 1911, and $300,000 in 1912 in two lots, $100,000 in the first lot and $200,000 in the second lot. In August, 1913, the last $100,000 worth of bonds were issued. All bonds were issued in denominations of $1,000 each, numbered from 1 to 500, inclusive, and are divided into five series, A, B, C, D, and E, respectively. The bonds are dated on March 1 of the year of issue, and are payable in installments of 10 bonds each, as consecutively numbered. Except for the last issue, 10 bonds become due 10 years after issuance and 10 bonds each year thereafter until the whole issue has been fully paid. The last issue is payable 10 bonds each year from 1915 to 1924. The interest is paid semiannually. The first $400,000 issue bears interest at the rate of 4½ per cent and the last $100,000 at the rate of 5 per cent.

The first issue sold for $104.01, the second for $105.53, the third for $105.5187, and the last for $100.537. No sinking fund is provided,

as the bonds are serial in character. The principal and interest are to be paid out of the tax levied especially for that purpose. This tax is assessed against all of the property in the county, including incorporated villages.

During the year 1911 the county issued $33,000 of bonds with which to pay the county's share of the cost of county highways, amounting to 20 per cent of the total cost, thus making the total bond issues $533,000.

In order to meet the interest charges and take up the bonds as they mature, the average annual outlay, covering the 50-year period from 1912 to 1961, inclusive, will be $21,735. The county will then have paid out a total of $1,068,500, of which $500,000 is the original principal and $568,500 the total interest charges. If the sinking-fund plan had been adopted instead of the deferred serial method, and 3 per cent could have been realized on the sinking fund, the average annual outlay for interest and sinking fund would have been $27,432.74, or a total for the 50-year period of $1,371,637, thus showing a total saving by the adopted plan of $285,137 over the sinking-fund plan. It is probable that the county would have found it more economical, however, to begin payments the fifth year instead of the tenth year, and to distribute the payments over 25 years instead of 50 years, as the life of the bonds would then more nearly approximate the duration of the improvements. Under such plan the average annual outlay would have amounted to $34,660, or a total for the 25-year period of $866,500. The average annual payments would have been $12,936 more than under the plan adopted, but the total amount paid out would have been $220,000 less than under the plan adopted, and the roads would have been paid for by the generation which receives the greatest benefit from them. To raise the $21,730, which will be the average amount required for interest and principal under the plan adopted, will require an annual levy of 1.72 mills on each dollar of the 1915 valuation, but if the bonds had been paid for by the 5–25 year serial plan the rate would have been 2.74 mills on the dollar. Furthermore, the 1.72 mills, or its equivalent, must be levied for 50 years, whereas the 2.74 mills would have been levied only 25 years. All highway taxes are levied of town valuations, and the rates vary in each on account of the variation in assessed values. In 1911 the rate varied from 4.95 mills to 19.1 mills, an average for the whole county of 8.37 mills. In 1913 the rates varied from 4.26 mills to 16.49 mills, an average of 9.39 mills.

ASSESSED VALUATION.

The equalized assessed valuation of property subject to taxation for road purposes in 1910, not including bank stocks, was $12,338,080, and in 1915, $13,201,055. The assessed value of real estate in 1910

was $11,741,490 and in 1915, $12,633,266, an increase of 7.6 per cent from 1910 to 1915, the period covered by the improvement of the roads. All property in the county is assessed at about 90 per cent of its real value. The bond issue represents about 3.8 per cent of the assessed value.

RECEIPTS FROM TAXATION FOR ROADS.

In 1910 the various towns raised $76,489.98 for roads. In 1915 there was raised by taxation $181,988.15, of which $88,934.83 was for town highways, $25,625 for State and county highways, $4,178.32 for interest on State and county highway bonds, $31,000 for maintenance of county roads, $22,250 for interest on county road bonds, and $10,000 for retiring county road bonds.

MANAGEMENT, PERSONNEL, AND COMPENSATION.

All State and county highways are built by contract let by the State highway department, which supervises the construction of such highways. County roads are built by day labor under the supervision of the county superintendent and the county highway commission, while the county superintendent and the respective town superintendents supervise the construction of town roads.

The State highways are designated by act of the legislature, but the choice between two or more routes is made by the State highway department. The board of supervisors designates county highways and county roads; and the town superintendents and town boards designate town roads for improvement.

The method of construction to be followed on State and county highways is determined by the State highway department, with the approval of the county superintendent. The improvements on town highways are designated by the county superintendent of highways.

The body in charge of the bond-built county roads is designated as the Franklin County Road Commission and consists of a president, secretary, and county superintendent of town roads, and two other members. Three members of this commission are appointed by the board of supervisors and are members of that board. The county superintendent occupies a position on the commission by virtue of his office. The fifth member of the commission is appointed by the other four. This commission acts for the county board of supervisors. The compensation of members of the commission is $4 per day for time actually employed, and expenses. The total salary and expenses of the commission for 1911 to 1913, inclusive, amounted to $5,596, exclusive of the salary of the county superintendent, which amounts to $2,000 per annum. An auditor is employed at $4 per day, a bookkeeper at $4 per day, and a stenographer

at $12 per week. These report to the county superintendent, who is supplied with an automobile furnished by the county board of supervisors, and directly supervises all engineering, construction, and maintenance work on county roads.

CONSTRUCTION COSTS.

Previous to 1910, all State and county highways in Franklin County were constructed of plain water-bound macadam. In 1910–11 the bituminous-macadam penetration method was used on State and county highways. The width between ditch lines on State highways is 32 feet, the road surface is 16 feet, and the depth of material is 6 inches. County highways are 26 to 28 feet between ditches, with the macadam 14 feet wide and 6 inches thick.

The stone-surfaced county roads built from bond-issue funds were surfaced to a width of 10 feet and to a depth of 6 inches, and the gravel roads to 12 feet in width and 7 inches in depth. The average width of county roads between ditch lines is 22 feet.

The town highways are usually surfaced with gravel to a width of 9 or 10 feet. The average cost per mile of the various classes of roads is shown in Table 17.

TABLE 17.

State highways (bituminous macadam)	$12,000
County highways (bituminous macadam)	11,000
County roads:	
Macadam	3,000 to 4,000
Gravel	1,900 to 2,500
Town highways:	
Macadam	1,800 to 4,000
Gravel	1,500

The above costs include bridges and culverts under 5-foot span. All culverts under 5-foot span are built by the towns, counties, or State, as the case may be, but all bridges over 5-foot span are built by the towns.

An examination of the bridge and culvert situation shows that from 1911 to 1913 the number of wooden bridges decreased from 407 to 355. Stone bridges decreased during that same period from 27 to 6. The number of concrete bridges increased from 62 to 112, and iron bridges from 179 to 192. Concrete culverts increased from 166 in 1911 to 816 in 1913. (See Plate XXI.)

The condition of some of the county roads before and after improvement is shown by Plate XX.

During the construction period common labor cost $1.75 per day; teams with driver, $4.25; foremen in charge of sections, $3.50; subforemen, $2.50 to $3; roller operators, $2.50 to $3; transit men, $3 and expenses; chain men and helpers, $1.50.

During the year 1911 the average cost of engineering on county roads in Franklin County was $17 per mile of road surveyed. During the year 1912 this had been reduced to $14.82 per mile for the total of 134.6 miles of road surveyed. As the county does no road work by contract, the quantities are not estimated in advance, and the cross sections are therefore not measured. This fact is largely responsible for the low cost of the surveys.

Most of the stone and gravel was donated. Many of the roads are built of crushed bowlders which have been taken off the fields and piled up at the roadside as fences. In some cases the county has paid for stone, the average being about 5 cents per cubic yard in the field. Where the stone was hauled to the crusher, the farmers were paid about 30 cents per cubic yard for delivering the same.

SURFACE TREATMENT.

Contracts were let during 1914 for the resurfacing of many of the State and county highways. About 45 miles of county gravel and macadam roads were treated with bituminous applications during 1913, at a cost of $0.011 per square yard. This work was continued during 1914 and a distributer has been purchased for this purpose. The roads are treated to a width of 7 to 10 feet.

EFFECT OF ROAD IMPROVEMENT ON LAND VALUES.

It is estimated that about 75 per cent of the land outside of the State forest reserves is tillable. The other 25 per cent is either covered with stone or so rough that it can not be used except for forest production or grazing.

The average farm contains 116 acres, and the average value of land per acre, including buildings, according to the United States census, was $32.40 in 1910. The value of good land in the county averages from $45 to $50 per acre. A study made in 1912 indicates that farms for sale on macadam roads were more valuable than those located on earth roads. Eleven farms containing 2,046 acres and located on earth roads were offered at an average of $23.48 per acre, while three farms located on macadam roads were offered at an average of $106.69 per acre for 239 acres.

Since the improvement of the road between Chateaugay and Chateaugay Lake, about 6½ miles, the value of adjacent land increased from about $50 to $60 an acre. The total cost of this road was about $22,750, while the increased value of three-fourths of the land within a half mile of the road on either side, according to the above figures, amounts to $31,200. It is estimated that about three-fourths of the land in that part of the county is either under cultivation or is tillable.

A few specific instances showing the increased value of land on roads which have been recently improved are presented in Table 18. The increased value does not include the increases due to the construction of buildings or other improvements. These farms are located in various parts of the county, and were selected at random, though it is believed that they are fairly representative.

TABLE 18.—*Increased values of certain farms located on roads recently improved.*

Type of road before and after improvement.		Size of farm.	Value per acre before improvement and from 2 to 3 years after.		Increase per acre.	Per cent of increase.	Miles to nearest shipping station.
Before.	After.		Before.	After.			
		Acres.					
Earth, sandy	Bituminous macadam.	84	$95	$119	$24.00	25.3	3.0
Part sandy	do	50	40	60	20.00	50.0	3.5
Fairly good	do	50	35	50	15.00	42.8	9.0
Loam, steep grade	Macadam	275	14	30	16.00	114.1	7.0
Earth and sand	do	120	40	50	10.00	25.0	1.5
Earth, sandy	Bituminous macadam.	77	52	64	12.00	23.1	1.0
Do	do	53	77	84	7.00	9.1	2.0
Earth, part sandy	do	125	46	52	6.00	13.0	2.5
Earth, very bad	Macadam	390	40	50	10.00	25.0	4.0
Weighted average		136	40.70	53.20	12.50	30.7	3.7

If it is assumed that farm values have increased at the rate of $10 per acre on all of the 492 miles of roads improved in the county, and that this increase affects only 40 per cent of the land lying within one-half mile of the roads on both sides, the total increase for the whole county would be $1,259,520. On the same basis this increase in valuation would amount to $345,600 for the 135 miles of bond-built county roads.

SOME EXAMPLES SHOWING SAVING IN HAULING COSTS.

Information covering a period of 3 years was obtained from 12 farmers and dairymen, and on this information estimates of hauling costs before and after the roads were improved are based. It was found that the average haul was 5.73 miles, the average cost of man and team $4 per day, the number of trips per day 1.92 and 2.63, respectively, before and after the roads were improved. The average load on the old roads was 2,392 pounds and on the new roads 5,557 pounds for a two-horse team. Using these figures as a basis a two-horse outfit would haul about 13.2 ton-miles per day on the old roads and about 41.8 on the new roads at an estimated cost of $0.303 and $0.096 per ton-mile, respectively, or at an estimated saving by improved roads of $0.207 per ton-mile.

Hauling costs furnished by a farmer and dairyman who owns a milk condensery at Fort Covington and a creamery at North Bangor deserves special mention. He stated that the cost for hauling

milk from Fort Covington to North Bangor over the old road, a distance of 15 miles, was about 20 cents per can (120 pounds), or about $0.22 per ton-mile, hauling 25 cans at a load. After the roads were improved he was able to increase the load to 40 cans for a two-horse outfit on the macadam and gravel roads. This is at the rate of $0.125 per ton-mile for a 15-mile haul, assuming the cost of team and driver to be $4.50 per day, which is slightly above the average for the county. (See Pl. XXIII, fig. 2.)

In May, 1914, this man purchased an automobile truck with which to do his hauling. The truck cost $1,750, and it is now doing the work formerly done by three 2-horse outfits. (See Pl. XXIII, fig. 3.) It makes two trips a day from North Bangor to Fort Covington and return, and also one trip a day to Westville, distance 7½ miles; total distance traveled, 75 miles per day; distance loaded, 37.5 miles. The load consists of 50 cans of milk (120 pounds each), a total net load of 3 tons, or 112.5 ton-miles per day. The weight of the truck empty is 4,800 pounds. The estimated cost of operating this truck for 200 working days when roads are not covered with snow is given in Table 19.

TABLE 19.

First cost, 3 ton truck		$1,750.00
Fixed charges:		
Interest	$87.50	
Insurance	85.00	
Driver	500.00	
Garage	50.00	
		722.50
Operating charges:		
Depreciation	262.50	
Gasoline	250.00	
Tires	400.00	
Maintenance	175.00	
Oil and grease	50.00	
		1,137.50
Total		1,860.00

The present cost per day, then, is $9.30, which for 112.5 ton-miles per day, or 22,500 ton miles in 200 days, makes the cost per ton-mile $0.0825. This man's hauling costs would therefore appear to have been reduced by improved roads and the automobile truck as shown in Table 20.

TABLE 20.

Horses and wagon on old roads	$0.22
Horses and wagon on new roads	.125
Automobile truck on new roads	.0825

APPROXIMATE TONNAGE HAULED TO MARKET OR SHIPPING POINT.

Table 21 gives the approximate tonnage of farm and forest products hauled to market over the county roads. This table is based on the production for 1910, as shown by the United States census upon the record of incoming and outgoing rail shipments, and upon information received from merchants and others in the county.

TABLE 21.

Product.	Annual tons hauled.	Product.	Annual tons hauled.
Hay	15,000	Fruits	500
Potatoes	25,000	Poultry products	250
Milk, cream, butter, etc	32,000	Animal products	1,500
Miscellaneous grains	600	Forest products, including cordwood	15,000
Hops	237		
Maple products	200	Total	90,287

APPROXIMATE TONNAGE HAULED TO FARMS.

The estimated annual tonnage hauled over the roads from railroad stations to farms is shown in Table 22. It will be seen that the estimated total annual traffic hauled over the country roads amounts to 145,287 tons. The traffic area for the county is estimated at 330,400 acres. The total tonnage hauled, therefore, amounts to 0.4 of a ton per acre. The average distance hauled is about 5.5 miles, which makes a total traffic for the county of about 799,078 ton-miles. The average cost of hauling over the old roads, based on the observations previously referred to, amounted to $0.303 per ton-mile, and on the new roads to $0.096 per ton-mile, making a saving of about $0.207 per ton-mile, or a total annual saving for the county of approximately $150,372. It is estimated that about one-third of this traffic passes over the bond-built roads, and, therefore, only about one-third of this saving, or $50,124, should be credited to these roads.

TABLE 22.

Material hauled.	Annual tons hauled.	Material hauled.	Annual tons hauled.
Fertilizer	5,000	Feed	15,000
Manure	10,000	Freight direct from railroad	5,000
Coal	15,000		
Hardware and building supplies	5,000	Total	55,000

During the spring of 1914, as a direct result of road improvement, two automobile bus lines were established—one between Malone and St. Regis Falls, 26 miles one way, and one between Malone and Fort Covington, 16 miles one way. The St. Regis line makes one trip a day, with rates of $1 for one way, or $1.60 for the round trip. The

Fort Covington line makes two trips a day and charges $1 for the round trip. They have a regular schedule as to time of arrival and departure from terminals and intermediate points, and a schedule of rates for intermediate points.

DALLAS COUNTY, ALA.

An object-lesson road constructed in 1909 under the direction of the Office of Public Roads of the United States Department of Agriculture started the movement for better roads in Dallas County, and in May, 1910, an election was carried for the issuance of $250,000 in county bonds. This sum was supplemented by an additional bond issue of $100,000 in July, 1912. The economic studies were made in March, 1911, April, 1912, April, 1913, April, 1914, and a short study in October, 1915.

The county is in the central part of the State and has an area of 940 square miles, or about 612,480 acres, of which about 256,000 acres constitute improved farm land. The principal product of the county is cotton, but about 40,000 acres are in corn, hay, and forage. Most of the county is level or gently rolling, and a small portion is hilly. The soil in the eastern part of the county is a sandy loam, while the western part is in the prairie section or Black Belt, which takes its name from the fact that the soil is very dark. The population of the county in 1910 was 53,401, of which 13,649 were comprised in the population of Selma, the county seat and principal city. There are about 1,000 miles of public road in the county, of which 217.9 miles, or 21.7 per cent, have been improved up to the year 1915. (See Pl. XXVI.)

HOW THE IMPROVEMENT WAS FINANCED.

The first $250,000 of bonds voted were sold in two lots of $100,000 and $150,000, respectively, on November 9, 1910, and July 3, 1911. The first issue brought a premium of $4,847.20 and the second issue $7,875. The $100,000 of bonds voted in 1912 were sold July 8, 1912, for a premium of $4,255. Thus the county had a total to apply to its road system of $366,977.20. The bonds all carry 5 per cent interest and run for a term of 30 years under the sinking-fund method. As no provision had been made to the close of 1915 for a sinking fund it is difficult to forecast just what the tax burdens will be to meet the indebtedness. It is understood that the county commissioners plan to buy up the bonds as fast as a surplus accumulates in the county treasury rather than maintain a sinking fund. This method would be far preferable to the maintenance of a sinking fund, provided the holders of the bonds are willing to surrender them at the amount of the original purchasing price, but this is an uncertainty, since it does not appear that the bonds have been issued subject to

call. If the bonds are retired on a straight sinking-fund basis and it is assumed that 3 per cent is realized from the sinking fund, the annual amount necessary to be raised would be $7,356 for sinking fund and $17,500 for interest, or a total average annual outlay of $24,856, and the total cost to the county for principal and interest would be $745,700. If 4 per cent is realized on the sinking fund the annual amount necessary to be raised would be $6,240 for sinking fund and $17,500 for interest, a total average annual cost for principal and interest of $23,740, or a grand total for the 30-year period of $712,200. Contrasted with this method, it may be pointed out that if the bonds were issued on a 5–30 year deferred serial method the annual cost would be $22,166 and the total cost $665,000, or a saving as compared with the sinking-fund method of $80,702 where only 3 per cent is realized on the sinking fund, or $47,216 if 4 per cent is realized. It therefore follows that if the commissioners take up the bonds only as they find it practicable, the relative economy as compared with the other two methods can not be determined until it is known what success they meet with in redeeming the bonds. The deferred serial method would have been free from this element of uncertainty, and the necessary tax rate could have been ascertained definitely.

There is no special tax levy to provide funds for the road bonds, as all the payments for interest and sinking fund are taken from the general county levy. In 1910 the general levy for county purposes was 5 mills on the dollar, in addition to which there was a levy of 2 mills for bridges and 6.5 mills for State purposes, or a total of 13.5 mills. In 1915 the tax rate had increased to 7 mills for county purposes, the bridge tax had decreased to 0.5 mill, and the State tax remained at 6.5 mills, making a total of 14 mills, or an increase over the 1910 rate of only 0.5 mill. There is also a statute labor or head tax of 10 days, which may be paid in cash at the rate of 50 cents per day. The poll tax, from which $1,519 was derived in 1915, is applied to schools. Just what the tax burden for the road bonds should be under the various possible plans may be indicated as follows: The assessed valuation for 1915 was $14,068,610. It would therefore be necessary to levy on such a valuation a rate of 1.76 mills on the dollar to produce the $24,856 annually to retire the bonds on the 3 per cent sinking-fund plan, or 1.68 mills to provide the $23,740 annually necessary if 4 per cent is obtained on the sinking fund. If the 5–30 year serial method had been adopted,the $22,166 annually required would be obtained by a levy of 1.56 mills on the dollar on the basis of the 1915 valuation. Therefore the construction of the improved roads under the bond issue represents an annual outlay constituting about 12.6 per cent of the total tax burden of the county. This should not prove oppressive, as it is probable that property values will increase and that the rate will correspondingly decrease. Even

on the present basis, however, a $5,000 farm, assessed at $3,000, which is about the average, would pay for the improved roads from $4 to $5 annually, according to the method which is adopted for payment of the indebtedness.

No aid was granted by the State toward the roads built under the bond issue, but an apportionment of $2,000 for each of the years 1911, 1912, and 1913 and $3,271.13 for 1914, or a total of $9,271.13, was granted by the State toward the cost of other roads whose construction was directed by the State highway department under a plan whereby the State and county paid, respectively, 50 per cent of the cost. Beginning with 1916, State aid must be applied to a trunk-line system designated by the State legislature. The average cost of the 9 miles of gravel road built with the aid of the State was $1,997.85.

HOW THE ROAD WORK WAS MANAGED.

The roads to be improved were selected by the county board of commissioners, which consists of the judge of probate, who is ex-officio president, and four members. The four commissioners are elected from the four districts of the county for a term of four years and receive $4 per day for time actually employed, or an average of from $600 to $800 per annum each. The commissioners have charge of the roads in their respective districts and employ overseers at $2 per day for time actually employed. These overseers have charge of the statute labor. The probate judge is elected for a 6-year term from the county at large and his compensation is based on the fee system. There are no other administrative road officials. An engineer was employed by the county board in 1911 at a salary of $3,000 per annum. His successor received $2,500 per annum, and the present engineer in charge of road work receives $150 per month and necessary expenses.

A superintendent of convict forces is employed at $95 per month, a bridge superintendent at $100 per month, and a superintendent of maintenance at $75 per month. These three officials report to the respective commissioners according to the district in which the work is conducted. Most of the construction under the bond issue was by contract either on the basis of a fixed charge per hour for labor and teams or on the unit-cost basis.

Gravel roads aggregating 78.45 miles and sand-clay roads 23.30 miles, or a total of 101.75 miles, were constructed with the bond-issue funds. The county is well supplied with clay gravel and with natural sand-clay. Where the wagon haul was excessive the materials were shipped by rail from the county gravel pit to the siding nearest the proposed improvement. This pit is located on a railroad siding and the material is excavated by steam shovel. The pit has a 28-foot

face, an area of 6 acres, and cost the county $100 per acre. The maximum output is 30 cars per day and the cost of operation about $300 per month. The plant handled enough material in a day to supply the railroad with sufficient ballast at 10 cents per cubic yard in addition to the gravel needed for the roads, to pay for the transportation of the road material.

The roads were graded 24 feet wide on embankments and 30 feet wide in cuts. The subgrade was prepared with road machines to an average width of 16 feet. The material, which was hauled in slat-bottom wagons and dumped three loads abreast (for a width of 16 feet), was spread and shaped with a road machine. No roller was used, and the material was consolidated by hauling over each previous day's work. The surface was shaped with a grader to a crown of about three-fourths inch to the foot. The depth of consolidated surface averaged from 7 to 9 inches. Private or farm roads entering on improved roads were surfaced for a distance of about 100 feet, in order to prevent tracking mud upon the gravel surface. Striking contrasts between the old and the new roads are shown in Plates XXV and XXVII.

Owing to the numerous small streams and creeks with large drainage areas emptying into the Alabama River, the cost of the highway system was exceptionally heavy. It has been the policy of the commissioners to bridge these streams with permanent structures of steel and concrete, and, while the bridges and culverts have been economically designed and erected, the number which had to be constructed caused the total cost to form a rather large percentage of the total expenditure for the road system. From the report of the county engineer on March 1, 1912, it is found that out of a total of $345,293.19 the expenditure for bridges was $83,192. Out of $252,924 expended from bond funds in 1912, a total of $32,570 was expended for 46 steel and concrete bridges, 11 concrete culverts, and 19 steel bridges paid for but not erected. The average cost of the roads constructed with bond-issue funds, including the outlay for bridges, was $3,606.66 per mile.

Aside from the bond-built roads and the State-aid road, the county had improved, up to the year 1915, 69.65 miles of gravel and 37.5 miles of sand-clay road. These were built by contract and by the convict forces. On April 1, 1912, the county owned 93 mules and considerable equipment, the whole valued at $27,922.

An average of from 20 to 60 convicts are regularly employed on road work, and these are worked in one gang. In 1913 the cost of operating the camp, including feed for four mules, was estimated at 50 cents per day per convict. Information furnished by the county officials in 1913 indicates that the average cost of building gravel

roads with this gang was $3,000 per mile, and of sand-clay roads from $1,500 to $1,800 per mile. The gravel roads were surfaecd 16 feet wide and 9 inches deep on road beds varying in width from 24 to 30 feet.

HOW THE ROADS ARE MAINTAINED.

The improved roads in the outlying districts are in excellent condition, but for a mile or two out of Selma some of the roads built in 1911 are rough and need to be resurfaced. The heavy repair and maintenance work is done by a gang employed continuously throughout the year, and composed of a foreman, 8 or 10 men, 10 mules, 2 road machines, 5 wagons, 2 drag scrapers, and some drags. The foreman is paid $75 per month, labor $1 per day. No information was obtainable as to mileage maintained and cost per mile. Some small repairs are looked after by the man-and-cart patrol system. Each outfit costs about $32 per month—$20 for the man and $12 for the mule. There are no toll roads in the county.

EFFECT OF ROAD IMPROVEMENT ON LAND VALUES.

As the road improvement was begun in 1910 the taxable valuations for that year and for 1915 have been compared to ascertain whether there has been an appreciable increase since the roads were improved. The total valuation in 1910 was $12,692,800, and in 1915 it was $14,068,610. As the effect of the road improvement would only be reflected in the real estate values, it was ascertained that real estate in 1910 was assessed at $7,604,440 and in 1915 at $8,534,445, an increase of 12.2 per cent in 5 years. This is not a radical increase, but is sufficient to indicate a normal, healthy development.

Personal investigation of sale values along the improved roads brought out the fact that the road improvement had added at least $5 to the value of each acre of land within one-half mile of the roads. On this basis the aggregate increases due to the road improvement would be $325,600. Of many specific cases recorded, it might be mentioned that one farm of 100 acres, assessed before the road improvement at $6 per acre, sold in 1914 at $48 per acre. The increase was entirely attributed to the road improvement. Another farm which was on the market at $10 per acre before the roads were improved was recently sold at $50 per acre. Tracts of land on another improved road which sold for $8 to $10 per acre before the road was improved, were recently sold again at from $20 to $25 per acre. Quite a number of instances were recorded of increases of from 50 to 150 per cent in value.

EFFECT OF ROAD IMPROVEMENT ON TRAFFIC.

The county is self-supporting from an agricultural point of view, and its outgoing shipments of general farm crops far exceed its incoming shipments, as indicated by the fact that in 1912 the outgoing

shipments of farm products at Selma alone amounted to 9,452.8 tons, as compared with only 569.9 tons incoming shipments of farm products, both exclusive of cotton. The farmers in this section are no longer relying solely upon cotton, but are devoting themselves more and more to general farm crops and to the raising of live stock and poultry. (See Pl. XXVIII.)

An indication of this change in agricultural methods is shown by the facts that there were 12 silos built in the county in 1914 and 42 in 1915, and that a creamery was built in Selma in 1915. This creamery now produces 1 ton of butter each week, requiring about 3 tons of cream, which is hauled in over country roads an average distance of about 4½ miles.

Nearly all products, except such as are consumed on the plantations, are hauled over the public roads to Selma. Comparatively little shipping is done from local stations. There is some shipping from Marion Junction, the radius for which is about 5 miles. The total rail shipments from Marion Junction in 1913 included 5,100 tons of hay, 2,500 bales of cotton, and 26 carloads of live stock.

The average load on the old roads was about 1,500 pounds, and on the new roads is at least 2,500 pounds, although much larger loads are frequent. On one of the improved roads about 10,000 pounds of bridge steel were hauled with 4 mules. From 8 to 10 bales of cotton or from 2 to 2½ tons are frequently hauled over the improved roads with 2 mules.

In 1915 there were 305 automobiles registered in the county, and it is estimated that at least one-half of the traveling salesmen who operate out of Selma use motor vehicles. One refining concern sends its motor truck all over the county. Three bottling works operate 5 motor trucks on country roads. Motor trucks also operate between Selma and Marion Junction, 14 miles, and Selma and Orrville, 16 miles, carrying supplies for merchants. The cost of operating these trucks per month is about as shown in Table 23.

TABLE 23.—*Cost of motor truck operation.*

Item.	Selma to Orrville, 25 trips, average load, 2 tons.	Selma to Marion, Junction, 42 trips, average load, 1½ tons.	Item.	Selma to Orrville (16 miles).	Selma to Marion Junction (14 miles).
Insurance	$14.17	$14.17	Depreciation	[2] $30.00	[2] $42.00
Privilege	[1] 12.50	12.50	Repairs	[1] 8.00	[1] 10.00
Driver	30.00	30.00	Interest	12.00	18.50
Helper	15.00	15.00			
Gasoline	25.00	58.64	Total	159.17	210.28
Tires	[1] 12.50	[1] 10.00			

[1] Estimated.

[2] Equivalent to 20 per cent.

The Orrville truck cost $1,800 and the Marion Junction truck $2,500. Assuming that they are loaded each way, the former will haul 1,600 ton-miles per month, at a cost of 9.9 cents per ton-mile, and the latter 1,764 ton-miles a month, at a cost of 11.9 cents per ton-mile.

The cotton crop which is produced on 160,000 acres constitutes the bulk of hauling. Each bale represents 500 pounds of lint and 1,000 pounds of seed. The average annual crop for the county does not amount to more than 37,500 tons, including seed. Practically all of this is hauled for some distance over the improved roads. General farm crops produced on about 40,000 acres amounted to about 30,000 tons in 1910, and this has materially increased since that time. Approximately 18,000 tons (or 900 pounds to the acre) are hauled over the roads. It is estimated that about 20,000 tons of fertilizer and about 10,000 tons of miscellaneous products and supplies are hauled over country roads from Selma and other distributing points to plantations in Dallas and adjacent counties. This makes a grand total tonnage hauled over country roads, as shown in Table 24:

TABLE 24.

	Tons.
Cotton and cotton seed	37,500
General farm products	18,000
Fertilizer	20,000
Miscellaneous	10,000
Total	85,500

The whole county constitutes the traffic area for the improved roads, but there are only 200,000 acres in crops. The total tonnage therefore represents about 0.11 ton per traffic acre or 0.43 ton for each acre in crops. The maximum haul for the county is about 28 miles, and the average haul from 8 to 10 miles. The average haul on the bond-built roads is about 8.4 miles. The total hauling over the bond-built roads is probably about 610,000 ton-miles, or about 84 per cent of the total. On the old roads the cost of hauling averaged about 30 cents per ton-mile, and on the new roads about 15 cents. The total annual saving, therefore, might be estimated at about $90,000.

LAUDERDALE COUNTY, MISS.

Road improvement was agitated in Lauderdale County in 1910, and after a brief educational campaign, bonds were issued by the county board of supervisors upon petitions submitted by taxpayers. The first bonds were issued September 1, 1910, and at various times thereafter to March 1, 1915, until they aggregated $500,000. They were not issued as county liabilities, but were chargeable to the respective beats, which correspond to townships in other States. The work of construction was begun during the spring of 1911 and the

last of the improvements contemplated in the first $450,000 of bonds issued were completed in the spring of 1915.

The county is somewhat larger than the average and has an area of 770 square miles or 448,000 acres. Less than one-fourth of the land is actually under cultivation. The population of the county in 1910 was 46,919, of which Meridian, the county seat and principal city, comprised 23,285. The products of the county are quite varied, as indicated by the fact that in 1910, 19,257 bales of cotton, 265,291 bushels of corn, 44,372 bushels of oats, 18,000 bushels of dry peas, and 121,000 bushels of potatoes were produced, and there were from 30,000,000 to 40,000,000 feet of yellow-pine lumber cut for shipment. Stock raising is also becoming an important industry.

The topography of the county is for the most part hilly, with small areas of rolling land and level creek bottoms. The soil varies from sandy loam to bright-red clay. During certain seasons the natural-soil roads are impassable for loaded vehicles, and therefore improved roads mean a great deal to the rural population.

The economic studies were made in March, 1911, and in April of 1912, 1913, 1914, with a short study in November, 1915.

HOW THE IMPROVEMENT WAS FINANCED.

Between September 1, 1910, and March 1, 1915, Beat 1, which includes the city of Meridian, issued $450,000 and Beat 5 issued $50,000 of road-improvement bonds. The total of all outstanding bonds must not, by the State law, exceed 10 per cent of the assessed valuation of all the taxable property in the county.

The bonds were issued by the county board of supervisors in accordance with the general law of the State. This law, adopted in 1910, provides that any county or district thereof may issue bonds on petition of 20 per cent of the qualified electors, provided the issuance of such bonds is not petitioned against by an equal number of qualified electors. If 20 per cent of the qualified electors petition against the issue of the bonds, then an election must be held, at which a majority vote decides the question for or against the issue. The bonds were issued without resorting to an election, except the last issue of $50,000. Table 25 shows the amount of bonds issued, dates of issuance, selling price, and interest.

TABLE 25.—*Road-improvement bonds issued by Lauderdale County.*

Date sold.	Amount.	Price obtained.	Interest.	Beat No.
			Per cent.	
Sept. 1, 1910	$50,000	$50,050	5½	1
Do	150,000	150,275	5	1
Mar. 1, 1913	100,000	100,110	5	1
Mar. 1, 1914	100,000	100,000	5½	1
Mar. 1, 1915	50,000	51,041	5½	1
Apr. 5, 1912	50,000	51,050	5½	5
Total	500,000	502,526		

The issues of 1910 to 1914, inclusive, have been spent in building roads in Beats 1 and 5, but no roads were improved with this money inside the city of Meridian. About one-half of the $50,000 issue of March 1, 1915, will be spent inside the city limits in connecting up the streets with the county roads.

The general law of Mississipi requires that all road-improvement bonds must be paid off within 25 years, and in annual installments after 10 years from the date of issue, and that they shall bear not to exceed 6 per cent interest, payable annually or semiannually. The bonds were issued in blocks of $500 each.

The first issue for Beat 1 of $50,000, bearing 5½ per cent interest and dated September 1, 1910, is payable as follows: 28 bonds of $500 each, payable each year on September 1, 1922 to 1924, inclusive, and 16 bonds on September 1, 1926.

The second issue for Beat 1 of $150,000, bearing 5 per cent interest and dated September 1, 1910, is payable as follows: 28 bonds of $500 each, due September 1 each year from 1925 to 1934, inclusive, except in 1926, when 12 bonds become due; in 1935, 36 bonds become due.

The third issue for Beat 1 of $100,000, bearing 5 per cent interest, and dated March 1, 1913, is payable as follows: 13 bonds of $500 each, due each year on September 1, 1923 to 1937, inclusive, and 5 bonds on September 1, 1938.

The fourth issue for Beat 1 of $100,000, bearing 5½ per cent interest and dated March 1, 1914, is payable as follows: 13 bonds of $500 each, due each year on September 1, 1924 to 1938, inclusive, and 5 bonds on September 1, 1939.

The fifth issue for Beat 1 of $50,000, bearing interest at the rate of 5½ per cent and dated March 1, 1915, is payable as follows: 6 bonds of $500 each, due each year on March 1, 1926 to 1935, inclusive, and 8 bonds of $500 each, due each year on March 1, 1936 to 1940, inclusive.

The issue for Beat 5 of $50,000, bearing 5½ per cent interest, and dated April 5, 1912, is payable as follows: 6 bonds of $500 each, due each year on September 1, 1923 to 1927, inclusive, and 7 bonds of $500 each, due each year on September 1, 1928 to 1937, inclusive.

The amount of interest which must be paid before the $500,000 of bonds are retired according to the plan above outlined will amount to about $472,232.

While the deferred serial method adopted by Lauderdale County is recognized generally as providing greater security and economy than the sinking-fund method, it would not seem wise to defer the beginning of the bond retirement to the tenth year. If a portion of the principal is paid between the fifth and tenth years, the burden of taxation is lightened by reason of being spread out over a longer period of time. If this is not done, the taxpayers will have expe-

rienced the benefit of the roads for 10 years at a low financial outlay, represented by payments of interest, and then when the great contrast between the old conditions and the new will have passed out of their minds they will suddenly be called upon to assume an increased financial burden in order to provide funds for the retirement of the principal.

The actual tax rate levied for interest on bonds in 1914 in Beat 1, which includes Meridian, was 1.5 mills and in Beat 5, 2.9 mills. In 1915 these rates had increased to 1.8 mills for Beat 1 and 3.4 mills for Beat 5, based upon the 1915 valuation of $12,874,856 in Beat 1 and $864,010 in Beat 5. If the bonds had been issued so as to have the payments begin the sixth year and continue to the twenty-fifth year, inclusive, the rate necessary to meet both interest and principal of $450,000 in Beat 1 would have been 2.53 mills, based on the 1915 valuation, or 0.88 mill more than the average of the rates actually levied for those two years. In Beat 5 the rate necessary to retire the bond issue on the same terms would average 4.28 mills, or 1.18 mills higher than the rate actually levied in 1915. Thus it appears that with tax rates almost as great as would be necessary under the 5–25 year plan the county is only succeeding in meeting interest charges.

It would be well if counties could so arrange their financial measures and so time the meeting of their obligations as to make the burden comparatively light at the very outset, thus giving the people a chance to develop their resources through the improvement of the roads. To do this the cost burden should be distributed so equitably over a period of years that it will avoid the two extremes of excessive tax levies on the one hand to pay off the debt too quickly, and the extension on the other hand of the debt beyond the life of the utility in order to obtain a low tax rate. An examination of the bond issue indicates that if the county had adopted the 5–25 year deferred serial method the total payments would be $65,357 less than they will be under the method actually adopted, if no sinking fund is established. As against this large difference it should be stated that the taxpayers are having the use of the money which they would have paid out if they had elected to retire the bonds more expeditiously. It is therefore a question as to whether this convenience is worth the price.

Taxation in the county does not differ materially from the rates in other localities, as in 1911 the total for all purposes, including the State tax, was 15.4 mills on the dollar. In addition to this property tax there is a commutation tax of $2 for road purposes and a poll tax of $2 for schools. In 1915 the average levy was 16.6 mills, of which the road-bonds tax comprised an average of about 1.6 mills and produced about 9.4 per cent of the revenue; the tax for maintenance

of the bond-built roads comprised 1 mill and produced about 4.9 per cent of the revenue; and the general road tax was 1 mill and produced about 6 per cent of the revenue, thus showing that the public-road revenue of the county comprised about 20 per cent of the total revenue of approximately $269,500.

The county road tax is levied against all taxable property in Meridian, but about one-half of the proceeds is used for streets inside the corporate limits. Since 1911 the tax rate for the city of Meridian has increased only 0.4 mill, in spite of the fact that it is paying 2.8 mills for interest and maintenance of bond-built roads. The rate for Beat 1, outside of the city, increased 3.4 mills during the same period, and the rate for Beat 5 increased 7.5 mills. The rate in Beats 2, 3, and 4 increased 0.6 mill, but none of the bond-built roads are located in those beats.

The general bonding law of the State requires that the tax for payment of interest and principal on the bonds be a special tax instead of having any of the expenditure paid out of other funds.

HOW THE WORK WAS MANAGED.

The roads constructed from the proceeds of bond issues were built by contract under the general direction of a county highway commission, consisting of three members appointed by the county board of supervisors for a term of 4 years. All important actions of the commission, such as letting contracts and paying out money, are approved by the county board of supervisors. The commission employed an engineer, and all work was done under his immediate direction. He made the surveys and prepared the plans, specifications, and estimates, which were approved by the commission and the board of supervisors before the contracts were let. All bills were checked by the engineer, approved by the commission, and paid on the order of the board of supervisors.

Positions on the road commission were honorary, and the commissioners acted without salary, but received $50 per annum for expenses. The commission went into office when the first bonds were issued, and has continued in office up to the present time with some changes in personnel. The engineer to the commission received a salary of $250 per month and the use of an automobile. He continued in office from the time the work started until the work was finished, about April 30, 1915. During the construction period an assistant engineer was employed by the commission at a salary of $90 per month. A new engineer was employed on May 1, 1915, to complete the work under the $50,000 bond issue of March 1, 1915. His salary is $135 per month, but is partly paid by the county board of supervisors for services rendered in connection with laying out roads for the county convict road forces. Before the bonds were issued

the county convict forces built roads without engineering advice or assistance, but the benefits resulting from the employment of a competent engineer have become so apparent in the county that no work is now done by the convict forces without first calling upon the engineer to survey and lay out the work to be done.

Ten main market roads radiating from Meridian like the spokes from the hub of a wheel (see Pl. XXXI) and one branch to a main road, aggregating 51¾ miles, were macadamized, and in Beat 1 the distances from the ends of the macadam portions to the beat line were surfaced with sand-clay, the total of this latter type in Beats 1 and 5 aggregating 45 miles. The improved roads, therefore, comprise a total of 96.75 miles, or about 12 per cent of the total of 800 miles in the county. The roads were graded 22 to 24 feet wide in fills and 28 to 30 feet wide in cuts, with 4-foot shoulders and 3-foot ditches. The macadam surfaces were from 14 to 16 feet wide and 6 inches thick consolidated. The sand-clay treatment usually extended from ditch to ditch. Natural sand-clay mixtures were principally used for this construction. The material for the macadam construction consisted of novaculite imported by rail from Tamms, Ill., a distance of 300 miles. The stone cost $1.10 per ton of 2,160 pounds, f. o. b. Meridian. The gravel used was shipped in by rail from Iuka, Miss., and cost $1 per ton f. o. b. Meridian, of which 30 cents was for material and 70 cents for freight. The weight was from 2,700 to 3,000 pounds per cubic yard. The average cost of constructing the roads, exclusive of bridges, was about $6,500 per mile for macadam and $2,000 per mile for sand-clay. The general average for the entire mileage was about $4,666 per mile. Most of the bridges were built of wood at a cost of about $3 per running foot.

For the ordinary road work of the county the convicts, averaging from 65 to 70, are regularly employed. These are divided into three camps and are used for grading and the building of sand-clay roads in the outlying districts, and for general maintenance work on all county roads. The cost of feeding, clothing, guarding, and medical attention, and the cost of teams and equipment, are paid out of the general funds of the county. The total cost of maintaining the three camps is about $38,600 per annum, and during the past 5 years they have constructed about 50 miles of sand-clay roads. This work was principally that of extension from bond-built roads to the county line. All road and bridge work in this county, amounting to more than $50, except that which is done by the convicts, must be done by contract. Very little work has been done, however, except by convicts and under the bond issues. The remarkable difference between a good and bad road is shown in Plate XXXII.

HOW THE ROADS ARE MAINTAINED.

An excellent provision in the general law of the State requires that a special tax of not less than 1 mill shall be levied for the maintenance of all roads constructed by means of bond issues. This fund is kept separate from all other funds and can be used only for maintenance. The result of this provision is that instead of deteriorating the roads have actually improved from year to year, and were in excellent condition at the time of our inspection in November, 1915. About a year after the gravel-macadam roads had been built, they were surface-treated with bituminous material, one-half to three-fourths gallon per square yard, and sand or slag screenings, at a total cost of about 7.3 cents per square yard. The roads are not considered finished until they have received this surface treatment. The width treated varies from 12 to 14 feet. All macadam roads in the county are now surface-treated, except 7 miles on the Russell Road and 2 or 3 miles on the Marion and Eighth Street Roads, which will be treated in the spring of 1916. The machinery, which was furnished by the contractor, consisted of rotary sweepers, compressed-air machine and tank, pressure distributers, and tank wagons for hauling heated material. Taking two of the principal roads, the following data show the cost of this work and afford a basis for estimating the cost for the whole county:

ASYLUM ROAD.

40,815 square yards; for purchase of material and its application at 5½ cents per square yard		$2,244.83
Additional expenses:		
Hauling hot asphalt	$103.60	
Hauling sand	251.50	
Traction-engine engineer, fireman, coal, etc	125.77	
Spreading sand	179.80	
Heating asphalt	80.00	
Incidentals (shovels, repairs, etc.)	10.94	
Patching	106.30	
Hauling water for traction engine	25.00	
Total		882.91
Grand total		3,127.74
Average cost per mile (for the 5 miles)		$625.54
Average cost per square yard		.0766

POPLAR SPRINGS AND MARION ROADS.

84,257 square yards; for purchase of material and its application at 5 cents per square yard		$4,212.85
Additional expenses:		
Hauling hot asphalt	$252.40	
Hauling sand	791.62	
Traction-engine engineer, fireman, coal, etc	284.45	

Additional expenses—Continued.		
Spreading sand	$285.85	
Heating asphalt	130.00	
Incidentals (shovels, repairs, etc.)	21.87	
Patching	64.35	
Hauling water for traction engine	11.25	
Total		$1,841.79
Grand total		6,054.64
Average cost per mile (for the 10 miles)		$605.46
Average cost per square yard		$0.072
Total number of square yards treated up to April, 1914		125,072
Total cost		$9,182.38
Average cost per mile over entire 15 miles		$612.16
Average cost per square yard		$0.073

The material was purchased and applied by contract at a fixed charge per square yard. The cost of this treatment and all additional expenses shown above were paid by the county from the bond-issue funds.

When roads begin to show signs of wear they are patched and re-treated. About one-fourth gallon of the material per square yard is used in the second treatment and the cost averages about $400 per mile, which includes $20 to $25 per mile for patching. The second treatment and all subsequent repairs are paid for out of the maintenance funds.

For keeping ditches open and for taking care of other small repairs, one man is constantly employed in Beat 1. He furnishes a horse, wagon, and small tools and is paid $80 per month. Extra labor is employed to assist him when necessary.

The sand-clay roads are worked over with road machines and dragged with split-log drags as often as necessary. The bond-built roads are maintained under the direction of the county highway commission, with the approval of the county board of supervisors.

There are no toll roads in the county.

EFFECT OF ROAD IMPROVEMENT ON LAND VALUES.

The taxable valuation in Lauderdale County in 1911 was $15,839,185, including the city of Meridian and the railroad property, and had increased in 1914 to $20,095,110.50. As the road improvement would have no direct bearing upon the assessed valuations of city and railroad property, a comparison of real-estate values outside the city of Meridian would afford more illuminating information in this connection. Such comparison shows that in 1911 the total assessed valuation of real property outside of the city was $2,757,546 and that it had increased in 1914 to $3,183,809, an increase during this period of road improvement of 15.4 per cent. A rather striking

fact in connection with the road improvement was that about 83 per cent of the tax for the payment of interest on bonds in Beat No. 1 is paid by the city of Meridian, although none of the roads are located within the corporate limits.

Personal investigation as to the effect of the road improvement on land values brought out many specific incidents of increases in values from 50 to 500 per cent coincident with the improvement of the roads. Lands 5 miles out from Meridian that were held at from $15 to $20 per acre before the roads were improved sold after the roads were improved for $50 per acre. For the purpose of illustrating more specifically the remarkable effect of the road improvement on property values, the following examples were selected on a single road leading out from Meridian:

A tract 4½ miles from Meridian, containing 40 acres, cost $1,000 in 1911, and in March, 1912, was sold for $1,900.

A tract containing 13 acres cost $1,000 in February, 1911, and was sold in the same year, after the road work had begun, for $2,000.

A tract containing 20 acres, 4 miles from Meridian, cost $500 in 1907; 13 acres sold in 1912 for $1,500.

An estate 4 miles from Meridian, containing 40 acres, was purchased in 1908 for $400. It was sold in 1911 for $1,700 after construction started, and was estimated to have been worth $2,500 in 1912.

A farm 5 miles from Meridian, containing 120 acres, was bought in 1907 for $900, and was sold in 1912 for $4,200.

A farm 4½ miles from Meridian, containing 200 acres, was estimated to have been worth $5,000 in 1911, but after the road was completed the owner refused an offer of $9,500.

A farm 4 miles from Meridian, containing 40 acres, was sold in 1910 for $2,500; in 1912 the owner refused $4,500.

The total of 473 acres in these tracts before the roads were improved was $11,300, or an average of $23.89 per acre, while after the roads were improved the total value was $26,100, or $55.18 per acre, an average increase of $31.29 per acre, or 131 per cent. Many small tracts of land, 2 or 3 miles from Meridian on the Poplar Springs Road, have sold, since the road was improved, for from $100 to $3,000 per acre. This property was all in farms before the road was improved and could have been bought for from $20 to $50 per acre. For 3 miles out this road is now lined with magnificent suburban homes.

Estimates of local men versed in real-estate values give the increase in land value, on account of improved roads, at from 25 to 50 per cent. According to the United States census of 1910, the average value of all farm land in Lauderdale County was about $10 per acre.

EFFECT OF ROAD IMPROVEMENT ON TRAFFIC.

There are five railroads in the county which converge at Meridian. These have a total of about 92.5 miles of road and 23 railroad stations. At Meridian alone 60,000 cars of freight, including 15,000 cars of lumber, are handled annually.

The traffic over some of the roads averages from 25 to 200 loaded vehicles per day at certain seasons of the year, with some of the wagons carrying from 2 to 3 tons. Practical examples of the small tractive resistance on the improved roads were demonstrated by drivers of freight wagons, who unhitched 2 or 3 yoke of oxen when macadam roads were reached and proceeded the remainder of the distance with a single yoke.

The total production of corn, oats, peanuts, peas, potatoes, hay, and forage in 1910 amounted to 17,212 tons, and of cotton and cotton seed 14,442 tons. The production of cotton has been reduced materially since 1910 on account of the boll weevil, but the production of general farm crops has increased probably in about the same proportion. Of these products it is estimated that 20,627 tons were hauled over the country roads to market or shipping point. There is practically no hay or forage hauled out of the county, but more hay is being grown in the county than ever before. In addition to this it is estimated that 4,500 tons of fertilizer and 60,000 tons of lumber are hauled over country roads, making a total of 85,127 tons. It is estimated that about one-half of this, or 42,563 tons, is hauled over the improved roads an average distance of 6 miles, equivalent to 255,378 ton-miles. This tonnage has not materially increased since the roads were improved. The traffic area for these roads embraces about 192,000 acres. The hauling over the improved roads, therefore, amounts to about 0.22 ton per acre for the traffic area.

The average load on the old roads for a two-horse team was 1,500 to 2,500 pounds, and on the new roads from 2,500 to 3,500 pounds. On the basis of an 8-mile haul as a day's work, with an average load of 1 ton and an average wage of $3 per day for man and team, the average cost per ton-mile over the old roads was $0.37. Based on a ten-mile haul, an average load of 1½ tons and an average wage of $3 for man and team, the hauling costs on the new roads average about 20 cents per ton-mile, a saving of 17 cents, or a total annual saving of about $43,400. If this saving could be applied to the payment of interest and principal, it would be sufficient to retire the $450,000 bond issue in about 17 years.

EFFECT OF ROAD IMPROVEMENT ON SCHOOLS.

Outside of Meridian there are 78 white and 53 colored schools. In Beat 1, where most of the road improvement has taken place, the average attendance in 1912 was 72 per cent, and in 1913, 81 per cent.

Two schools in Beat 1 were consolidated by reason of the better roads and one school was discontinued, as the children are now able to attend school in Meridian. These two changes have resulted in a net saving to the county of $100 per month for teachers' salaries.

VALUE OF THE ROADS TO THE COMMUNITY.

In order to bring out an expression of opinion as to the value of road improvement, an inquiry was addressed by a local paper to prominent citizens living on the improved roads. From the replies received, the following quotations are made:

(1) It is impossible to enumerate the advantages of such a road as this; it is the only time in my life that I have ever realized any direct benefits from taxation, but paying taxes for road improvement with me after seeing and realizing what it means to the whole country is a pleasure; and I don't think you can burden a man with taxation when he gets results like this from it.

(2) I have heard compulsory education agitated, but if I was a member of the legislature I would offer a resolution advocating compulsory road construction, for a man that is opposed to it is either ignorant of what it means to him or is a fool, and I think the State ought to look after such people. I get pay over and over every week of my life for what it costs me by watching the school children pass my house to and from school, perfectly comfortable regardless of weather conditions. I am one of the trustees of our school and just a day or two ago I signed the school report, showing a total enrollment of 130 and an average attendance during the month of December of 109. As you know, December was one of the worst months we ever experienced in this county.

(3) I have never made an investment for which I have gotton as much financial returns and satisfaction as I have out of this road. The advancement in property alone has been sufficient to four or five times pay the whole cost of construction, and I don't think the county could make any investment that would bring in as much returns as to build a network of them all over it. It is such a good thing that I want every man in the county to have one just like it, and I am willing to pay my part of the taxes to help him get it.

(4) I live 4 miles from the city and 2 miles from the school. This has been the worst winter that I have ever seen, but there hasn't been a single day that my children haven't walked to school and not a single day have they come home with wet feet; and to think they walked down the middle of the road. Not one of them has been sick with a cold even, while heretofore my doctor bills have been more than my road tax. Talk to me about paying taxes to build roads! I am willing to pay taxes on my pack of fox hounds, my bird dog, my chickens, my horses, and if necessary my wife and children, if they will use it in extending roads like this all over the county. I would rather have my house and 10 acres of land on this road like it is now than have my whole farm on the old road like it was before improvement.

(5) The good roads have made it possible for me to live at my country home and still attend to my business affairs in Meridian, just as easily as though I lived in town. The benefit that strikes me as being most practical and far-reaching is the tremendous increase in real-estate values of country property located on the good roads. I have been especially interested in this feature and have found that in every instance into which I have inquired farms located on the good road have been enhanced in value from 50 per cent to 100 per cent as a result of the building of the good roads. I am heartily in favor of good roads and firmly believe that everybody would be so if they had the opportunity of using one for a short time.

In contrast to the above, the following is quoted from the reply received from a farmer and merchant living on the Bonita Road, which has since been improved (see Pls. XXIX, XXX, and XXXIII):

(6) There hasn't been a time since the 1st of December that I have been able to get anything hauled to my place from Meridian, just 4 miles, for less than 25 cents per hundred; in the majority of instances it has cost me as high as 50 cents, and a good many times it has been impossible to get it at any price; the people in my community have actually had to go without oil for their lamps for a week at the time because they couldn't get it; if these conditions are not a heavier tax on the people than paying for the construction of roads, then I am a bad judge and a bad mathematician.

MANATEE COUNTY, FLA.

The movement to improve the more important roads of the county was begun in 1909 and was due to the fact that fruits and vegetables, for which the climate and soil were particularly favorable, could not be hauled over the sandy roads except at prohibitive cost. (See Plate XXXIV, fig. 1.) Furthermore, the county could not hope to attract tourist travel unless an adequate system of roads was provided. As a result of the movement, $250,000 of road bonds were voted on September 1, 1909, but on account of injunction proceedings to prevent the issuance of the bonds, work was not begun until the spring of 1911.

The county is located on the west coast just below the lower end of Tampa Bay and has a land area of 1,337 square miles, or 855,680 acres, of which in 1910 only 14,173 acres, or 1.7 per cent of the total, were in improved farms. It is thus evident that the county had scarcely begun to develop its resources at the time the road building was begun. The population was 9,550 in 1910, and several towns in the county were, at that time, rapidly assuming importance as winter resorts. The surface is practically flat and most of it only a few feet above sea level, and the soil varies from light gray sand to fine sandy loam. The principal products are grapefruit, oranges, and other semitropical products, small fruits, and vegetables, which are mostly shipped to northern markets during the winter months.

The economic studies were made in April, 1911, May, 1912, April, 1913, April, 1914, and February, 1915.

HOW THE IMPROVEMENT WAS FINANCED.

The bonds which were issued February 24, 1911, as of September 1, 1909, are 30-year sinking-fund bonds, bearing interest at 5 per cent. A premium of 1 per cent was obtained, making a total available for road improvement of $252,500. Owing to the fact that 5 per cent is obtained on the sinking fund, the financial burden upon the county is very little more than it would be if the deferred serial method had been adopted. In explanation of how the county was able to secure 5 per cent on the sinking fund, it may be stated that

this fund is deposited with the bond trustees of the county, consisting of three bankers, and by them invested in securities which must be equally as good as the bonds. The trustees are planning to buy up the road bonds whenever their funds are sufficient to do so and the bonds are available for purchase. It is planned to retire $3,000 of the bonds during 1916. The weakness of the plan adopted lies in the extreme improbability that 5 per cent will continue to be obtained on the sinking fund. If the county succeeds in obtaining over the entire period an average of more than 4 per cent on its sinking fund, it will have accomplished more than could reasonably be expected.

As an indication of how the sinking-fund method compares with the deferred serial method, it might be pointed out that the annual outlay for interest and retirement of the $250,000 bond issue under the former, with interest on the sinking fund at 4 per cent, would be $16,957.53, and under the deferred serial method, with the bonds running 5–30 years, the annual outlay would be $15,833.33. If the county, however, succeeds in obtaining 5 per cent on the sinking fund throughout the entire period the annual outlay will be $16,262.85.

It would, therefore, appear that if the deferred serial plan had been adopted instead of the sinking-fund plan, with interest on sinking fund producing 4 per cent, a total saving of $33,725.75 could be realized, but if the sinking fund produced 5 per cent the saving would be only $12,855.50. This latter sum is, however, equivalent to about 5 per cent of the total bond issue and would have been sufficient to pay for all engineering expenses.

To provide an annual outlay of $16,262.85, a levy of about 2 mills on each dollar of assessed valuation will be required on the basis of the present assessment, but naturally this rate will decrease as the assessed values increase.

The tax levy for the road bonds in 1910 amounted to 7 mills and in 1915 to 3 mills. The sinking fund contained $47,396.98 on December 1, 1915, which indicates that the rate of accumulation is greater than necessary to retire the bonds in 30 years.

A comparison of tax rates for the years 1905, 1910, and 1915 reveals the fact that there has not been a very great increase in the rate on account of the road improvement, as the total rates were 24 mills in 1905, 26½ mills in 1910, and 26 mills in 1915, and that while the 24-mill rate produced only $49,472.86 in 1905, the 26-mill rate produced $178,420.89 in 1915. In other words, while the tax rate increased during that period only 10 per cent, the receipts increased 260 per cent, indicating a remarkable increase in taxable wealth. While there was a levy of 3 mills in 1915 for road bonds, as compared with no levy for that purpose in 1905, the levy for general county

purposes decreased 1½ mills; the levy for outstanding road warrants, which was only 1 mill in 1905, had been eliminated in 1915; the levy for school indebtedness, which amounted to 3 mills in 1905, was absent in 1915; and the levy of 1 mill for county clerk's office indebtedness in 1905 had been eliminated in 1915; so that these savings more than compensated for the increase due to the road bonds, and made it possible to increase the general levy for roads and bridges of 3 mills in 1905 to 5 mills in 1915, and to make a 3½-mill levy in 1915 for county buildings. As compared with 1910, it will be noted that the tax rate for 1915 was one-half mill less and that in spite of this reduction the receipts from taxation increased 140 per cent. A further rather interesting comparison is shown by the fact that while in 1905 the roads required 25 per cent of the taxes, they required, including bond taxes in 1915, 33.2 per cent of the taxes.

The road and bridge taxes and the road-bond taxes are levied on all property in the county, including incorporated cities, but one-half of all road and bridge taxes collected from cities are returned to them for the improvement of streets within corporate limits. In addition to the regular road tax there is a statute labor tax of 3 days or $3 for all residents of rural districts who are non-freeholders. The amount of work accomplished and the receipts from this source, however, are inconsiderable.

On January 18, 1910, Englewood district voted $75,000 worth of road and bridge bonds, but they have not yet been issued. With this money 26 miles of road are to be graded and a portion of the road surfaced with sand-asphalt.

On January 11, 1916, the Sarasota-Venice district voted $250,000 worth of road and bridge bonds. Of this amount $210,000 will be expended for roads and $40,000 for bridges. With the $210,000 it is proposed to build 34 miles of sand-asphalt roads and grade 14 additional miles. The deferred serial type of bonds will be issued in both of these special districts. They will bear 6 per cent interest and will be retired in 5, 10, 15, and 20 years.

Manatee district is contemplating the issuance of $239,000 of road and bridge bonds.

The county has $97,445 of outstanding warrants which were issued for the purpose of building a court house. These bear 6 per cent interest and are to be paid off in five annual installments, covering the period 1913 to 1917, inclusive. There are also $285,000 of school warrants outstanding. These bear 6 per cent interest and must be paid in 20 years.

From the above it will be seen that the total debt of the county is $957,445, which represents 11.8 per cent of the 1915 assessed valuation.

HOW THE WORK WAS MANAGED.

The board of county commissioners has sole jurisdiction over the construction and maintenance of public roads, including those built under the bond issues, and consists of five members, of whom one is elected for each of the five districts. They are elected for 2-year terms and receive $4 per day for time actually employed, not to exceed $200 per annum. They are allowed mileage extra.

The clerk of the circuit court acts as clerk and accountant to the board of supervisors. The clerk's compensation is derived from fees and he receives no extra compensation from the board.

An engineer was employed by the county commissioners, under whose immediate supervision all bond-built roads were constructed. The engineer received $10 per day for time actually employed, and expenses. During the construction period he received approximately $5,000, not including transportation.

The county engineer now employed by the county commissioners for general road and bridge work receives a salary of $150 per month and the use of an automobile. For the Venice-Sarasota district an engineering firm has been employed to do all engineering work. Compensation will be 4 per cent of the total expenditure of $250,000.

The roads to be improved were selected by the board of county commissioners prior to the bond election. The bond issue called for the construction of 64.4 miles of road, which was done under contract let by the board. The total mileage constructed was 63.65 or 11 per cent of the total of 575 miles in the county. The accompanying map (Pl. XXXV) shows the roads constructed under the first bond issue and those proposed for construction with bond funds subsequently provided.

The mileage and character of surface constructed under the original bond issue were as follows: Marl and rock, 15.187; marl rock with bituminous binder, 17.050; marl and shell, 9.850; shell, 14.171; brick, 1.00; graded, 6.40; making a total of 63.658 miles constructed. (See Pl. XXXVI, figs. 2 and 3.)

These roads were completed during 1913. The local materials available for road work are soft limestone and flint rock, marl, and shells. The shells are obtained from mounds in various parts of the county, and the other materials are fairly well distributed. These materials are suitable for roads of light traffic, but considerable expense will be entailed in keeping the roads in good condition because of the automobile traffic and the heavy tonnage of fruits and vegetables which pass over them. The expense of shipping in more durable materials led the county authorities to build the roads of local materials and to depend upon bituminous applications to preserve their surfaces.

The marl-rock and limestone roads were surfaced to a width of 9 to 12 feet and were built in two courses. The first course was 6 inches in depth loose and the second course 3 inches loose. The shell roads were surfaced to a width of 9 feet and to a depth of 12 inches loose. All rights of way were cleared to a width of 30 feet.

The average cost of the 63.658 miles built, including culverts and bridges, was $3,966.50 per mile. The average cost per mile of the shell road was $2,400; marl-rock macadam, $3,800; and flint-rock macadam, $4,700 per mile. A contract let on April 21, 1911, contains the following unit prices: Clearing and grubbing, $40 per acre; grading, $0.10 per square yard; filling, $0.20 per cubic yard; marl in place, $0.75 per cubic yard; stone in place, $3.25 per cubic yard; screenings, $2.75 per cubic yard; sewer pipe in place, $0.70 per linear foot; and concrete in place, $6 per cubic yard.

HOW THE ROADS ARE MAINTAINED.

The improved roads have not been systematically maintained. The shells and marl rock of which most of the roads were built are soft, and these materials have not stood up well. The finer materials have worn and blown away and many of the roads are full of ruts and depressions. Some of the worst places have been patched. About 17 miles of rock roads were surface treated with bituminous material when they were constructed, but this treatment has not been renewed, and practically all of the original surface has disappeared.

The road from Manatee to Sarasota, about 10 miles, was resurfaced in February, 1916, and treated with bituminous material. The surface was scarified and shaped, after which a 2-inch layer of lime rock was applied and rolled. By means of a pressure distributor from 0.5 to 0.6 gallon per square yard of bituminous materials was then applied and sanded. After about 10 days a second application of bituminous material consisting of from 0.2 to 0.3 gallon per square yard was applied and sanded. The road was treated to a width of 10 feet and the work done by contract at a cost of 39 cents per square yard, or a total cost of $2,288 per mile. This, as with all other maintenance work of the county, was paid for out of the regular road funds.

The repair and maintenance work is done under the general direction of the county engineer and under the immediate direction of road overseers. There are 13 road overseers in the county, whose pay is $3 per day for time actually employed. Laborers employed for patch and repair work receive $1.50 per day. For use in this work the county owns a caterpillar tractor, 3 road graders, and 2 teams.

EFFECT OF ROAD IMPROVEMENT ON LAND VALUES.

It is difficult to determine what effect the road improvement has had upon the increase in assessed valuation of property in the county, but it might be well to compare the increase in valuation during the

period 1905 to 1910 and between the latter date and 1915, thus obtaining a 5-year period between which no roads were improved and a 5-year period during which the improved road system of the county was constructed. In 1905 the assessed valuation of all taxable property was $2,074,016, while in 1910 it had increased to $2,821,813, or 36 per cent. The assessed valuation in 1915 was $8,085,100, a total increase of 180.5 per cent, so that the rate of increase was nearly six times as great as during the preceding 5 years. Comparing real estate only, it is shown that the assessed valuation was $1,798,936 in 1905, $2,492,232 in 1910, and $7,338,050 in 1915. The increase was therefore 38.5 per cent from 1905 to 1910, and 194 per cent between 1910 and 1915. It is estimated that property is assessed at about one-third of its true cash value. The large 1915 assessment is due partly to the fact that until a few years ago property was assessed at only about 20 per cent of its value. A new railroad has been built in the county, and this, together with the improved highways, has resulted in bringing under cultivation large tracts of land which were formerly nonproductive.

A personal inspection to determine the effect of the road improvement on land values brought out the fact that there is a wide variation in land values, due partially to the relative fertility of the soil and partially to the transportation facilities. For example, the orange and grapefruit orchards, located on fertile "hammock" lands within easy hauling distance of the railroads or steamboat landings, are valued at from $400 to $600 per acre, while unimproved sandy pine lands within 3 miles of Manatee sell at from $35 to $40 per acre. Some of the low-priced lands had increased $25 per acre, while uncleared pine land, which had sold during the preceding year at $40 per acre, had increased in value to $60 adjacent to the road and $50 a mile from the road. As examples of values, it may be stated that a tract of 40 acres of land sold in 1911 for $10 per acre was resold in 1912 for $37.50 per acre. For another tract, which could have been bought in 1910 for $20 per acre, $100 per acre was refused in 1912. A tract of 1,000 acres 6 miles south of Manatee was purchased before the roads were improved at $10 per acre, and where this land abutted on the improved roads it sold during 1913 for $75 per acre, and for $55 to $60 per acre within one-half mile of the improved road.

A member of a real-estate firm of Bradentown stated that land which sold at $20 per acre before the road improvement sold at $50 per acre since the roads were constructed, and that lands were sold after the road construction which could not have been sold at any price before. Other examples illustrating the effect of the improved roads on land values are given, as follows:

A prominent citizen of Sarasota bought a tract of 29 acres about a year ago for $10,000, or $344 per acre, and resold April, 1914, for

$15,000, or about $517 per acre. A brick road is to be built by this place.

A tract of 40 acres one-fourth mile off Manatee-Sarasota Road (see Pl. XXXIV, fig. 2), 6 miles north of Sarasota, which was unsalable before the roads were improved, recently sold for $2,600, or $65 per acre.

Between Sarasota and Fruitville, along the improved road, a 10-acre tract was being held for $2,500, or $250 per acre.

On Manatee-Sarasota Road, about 2 miles south of Manatee, 15 acres of uncleared land was offered in 1913 for $2,500, or $166 per acre.

Another tract of 55 acres, 4½ miles out of Bradentown, on the Palma Sola Road, which sold at the time of completion of the road for $20 per acre, was again sold 2 years later without additional improvements for $50 per acre. On the Palma Sola Road, about 5½ miles from Bradentown, a tract containing 160 acres was originally set to grapefruit. When the road was improved the owner sold 40 acres for $1,000, and this has since been subdivided and resold for over $6,000.

A tract of a little more than 400 acres along the road from Ellenton to Parrish, about 2 miles above Ellenton and 1½ miles off the road, recently sold for $20 per acre. The same land was offered 2 years ago for $10 per acre, but a purchaser could not be found.

Additional examples of the increased land values might be given, but the foregoing statements are sufficient to show that the increases have been remarkable and that the improvement of the roads has probably done more to bring this about than any other factor. From all of the information available it appears that there have been added from 50 to 100 per cent or at least $15 per acre to the selling price of all lands within one-half mile of the new roads, a total of approximately $611,000, which is more than twice the value of the bonds issued.

EFFECT OF ROAD IMPROVEMENT ON TRAFFIC.

To ascertain the volume of traffic on the improved roads and the relative cost of hauling before and after the roads were improved, information was obtained as to the farm production during the years 1912 and 1913. It was found that in 1912, 3,720 acres of land were devoted to the raising of vegetables and 4,950 acres were devoted to groves of citrus fruit in bearing. In 1913, while there had been no material increase in the citrus-fruit acreage, the area devoted to vegetables had increased to 5,195 acres. The yield of tomatoes alone during the season of 1913–14 was 450,000 crates or 11,250 tons. The yield of cabbage was 128,000 crates or 6,400 tons. Celery comprised 336,000 crates or 13,440 tons, and citrus fruits yielded a

total of 1,000,000 crates or 40,000 tons. These four crops—tomatoes, cabbage, celery, and citrus fruits—for the season of 1913 comprised about 71,090 tons, to which miscellaneous vegetables and fruits added approximately 10,000 tons, making 81,090 tons of outgoing farm products. The average load on the old sandy roads was about 750 pounds for a one-horse team and about 1,500 pounds for a two-horse team, and the rate of wages was about $4.50 to $5 for a two-horse team and driver for a 10-hour day. The average haul over the old roads was approximately 2½ miles, with a maximum of five trips per day, or about 10 ton-miles per day for each two-horse team, which made the cost of hauling approximately 45 cents per ton-mile. It was found that 4,800 pounds could easily be drawn by a 2-horse team after the roads were improved. In order to be entirely conservative, however, the average load on the improved roads is estimated at 3,500 pounds, the number of trips per day 5, the same as before the roads were improved, and the cost per day for team and driver $4.50, the same as on the unimproved roads; the average haul 2½ miles, the same as on the unimproved roads; and with these factors the average cost of hauling by a 2-horse team is about 20 cents per ton-mile, or a saving of approximately 25 cents per ton-mile, as compared with the hauling cost on the old roads.

Based upon information secured from railroad officials, local business men, and fruit and vegetable growers, it is estimated that about 33⅓ per cent of the outgoing rail shipments, 85 per cent of the outgoing shipments by water, and 20 per cent of the incoming shipments pass over the improved roads. On this basis the annual traffic on the improved roads for 1915 was estimated to be 52,117 tons, or 130,292 ton-miles. If the saving of 25 cents per ton mile is applied to this amount it indicates an annual saving of $32,573. As the tonnage increases from year to year the benefit of the improved roads in the way of reducing hauling costs will be more and more apparent, and there can hardly be a doubt that the investment will prove a profitable one.

OPRRE 3529

FIG. 1.—COURTHOUSE ROAD, MARCH, 1910, SPOTSYLVANIA COUNTY, VA.
Unbroken wilderness and no human habitation.

OPRRE 4966

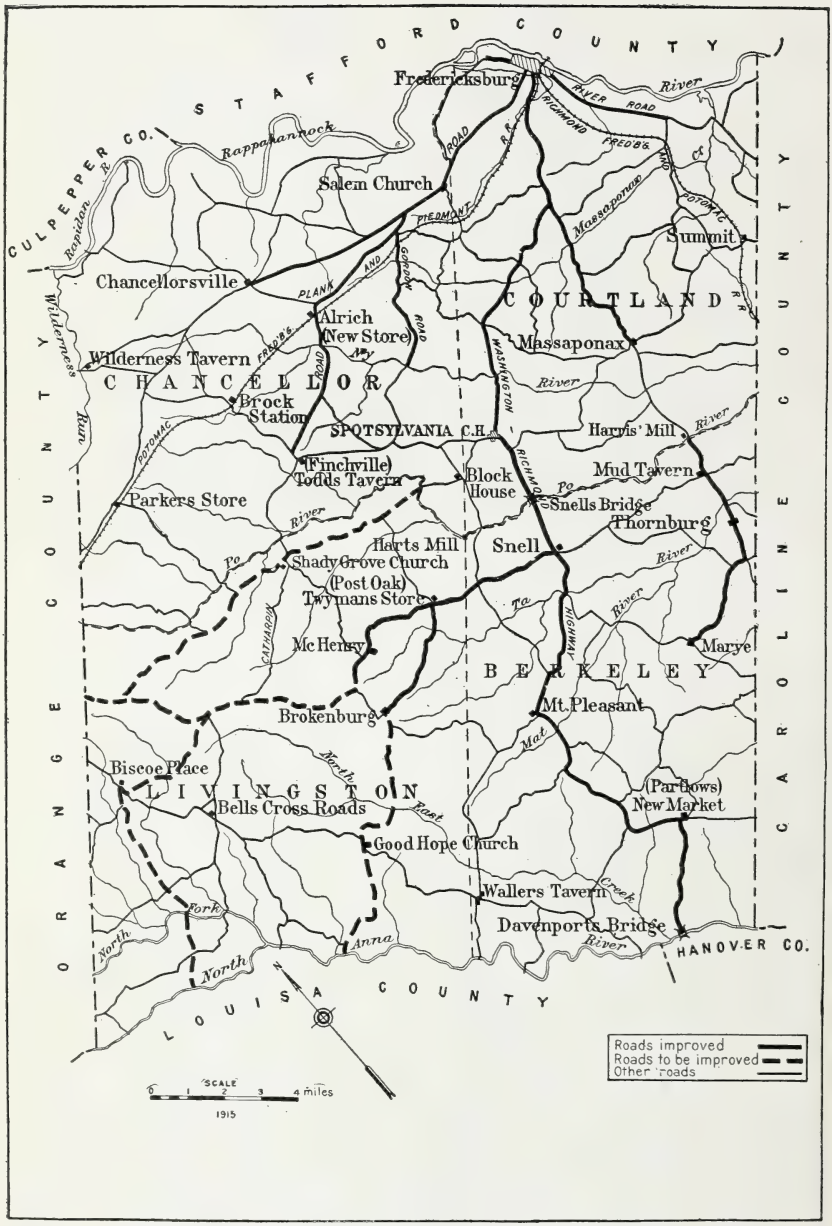
FIG. 2.—COURTHOUSE ROAD, MARCH, 1911, SPOTSYLVANIA COUNTY, VA.
Clearing begun and house erected.

OPRRE 11753

FIG. 3.—COURTHOUSE ROAD, APRIL, 1912, SPOTSYLVANIA COUNTY, VA.
Land cleared and more houses built.

OPRRE 6691

FIG. 4.—COURTHOUSE ROAD, NOVEMBER, 1914, SPOTSYLVANIA COUNTY, VA.
Houses improved, note porch upon one; the farther one newly painted white; also see new fence.



MAP OF SPOTSYLVANIA COUNTY, VA., SHOWING ROADS IMPROVED AND TO BE IMPROVED.

OPRRE 3538

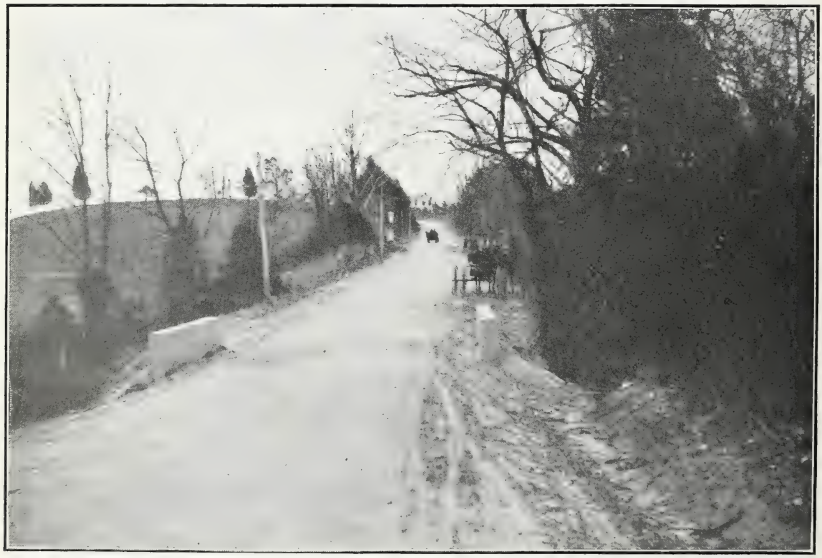
FIG. 1.—COURTHOUSE ROAD, MARCH, 1910. BEFORE IMPROVEMENT.

OPRRE 9221

FIG. 2.—COURTHOUSE ROAD, APRIL, 1913. GRAVEL, AFTER IMPROVEMENT.

OPRRE 6795

FIG. 1.—WOODEN BRIDGE FAILURE ON CHANCELLORSVILLE ROAD, MARCH, 1910, SPOTSYLVANIA COUNTY, VA.



OPRRE 6795

FIG. 2.—SAFE AND LASTING CONCRETE BRIDGE ON GRAVEL ROAD, SPOTSYLVANIA COUNTY, VA.

Same location as above, April, 1913.

OPRRE 3526

FIG. 1.—TRAFFIC ON COURTHOUSE ROAD, MARCH, 1910, SPOTSYLVANIA COUNTY, VA.

Load for 1 horse, 4 cross ties or 800 pounds.

OPRRE 10538

FIG. 2.—TRAFFIC ON COURTHOUSE ROAD, FEBRUARY, 1914, SPOTSYLVANIA COUNTY, VA.

Load for each horse about 2,000 pounds.

OPRRE 3535

FIG. 1.—SCHOOL BUILDING AT SPOTSYLVANIA COURTHOUSE, MARCH, 1910, SPOTSYLVANIA COUNTY, VA.

OPRRE 11809

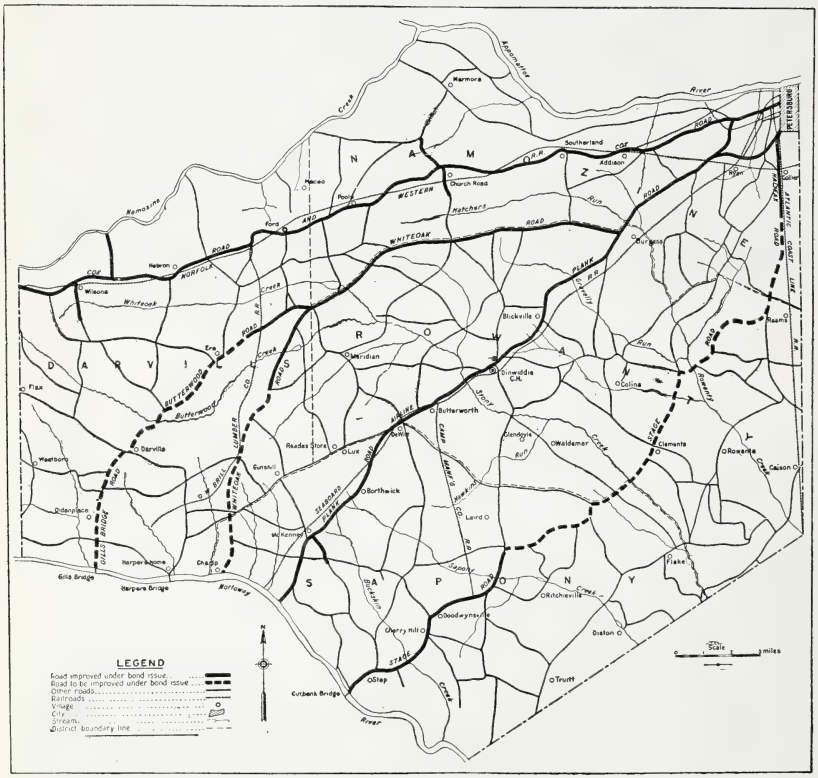
FIG. 2.—THE OLD AND NEW SCHOOL BUILDINGS AT SPOTSYLVANIA COURTHOUSE, 1914, SPOTSYLVANIA COUNTY, VA.

OPRPE 3571

FIG. 1.—WHAT WAS CALLED BOYDTON PLANK ROAD IN MARCH, 1910, DINWIDDIE COUNTY, VA.

OPRRE 6825

FIG. 2.—SAME SECTION AS ABOVE AFTER IMPROVEMENT, MARCH, 1912, DINWIDDIE COUNTY, VA.


LEGEND
Road improved under bond issue
Road to be improved under bond issue
Other roads
Railroads
Village
City
Stream
District boundary line
Scale
3 miles
Harmony
Hasco
Church Road
Southerland
Addison
Burgess
Blackville
Meridian
Dinwiddie C.H.
Butterworth
Reams
Colina
Clements
Rowanty
Cason
Waldemar
Darvilla
Reades Store
Dale
Gunsho
Borthwick
Laird
Westborn
Odenplace
Harpersboone
Chapo
Gills Bridge
Harpers Bridge
Woolfolks
Kennon
Flake
Ritchieville
Woodwynnville
Cherry Hill
Dyson
Trutt
Stop
Curbens Bridge
Whiteoak
Buffaloed
Fox
Flax
Wilsons
Nemozine
Creek
River
Road
Run
Branch
Church
Western
Hatchers
Norfolk
Plank
Stony
Namozine
Rowanty
Stage
Jones
Sturgeon
Cypress
Jehosh
Bull
Cedar
Flake
Dyson
Trutt
Stop
Curbens
Woolfolks
Harpers
Gills
Chapo
Odenplace
Westborn
Darvilla
Reades
Dale
Gunsho
Borthwick
Laird
Kennon
Flake
Ritchieville
Woodwynnville
Cherry Hill
Dyson
Trutt
Stop
Curbens
Waldemar
Clements
Rowanty
Cason
Colina
Reams
Dinwiddie C.H.
Butterworth
Meridian
Blackville
Burgess
Addison
Southerland
Church
Hasco
Harmony
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Fox
Flax
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Cherry Hill
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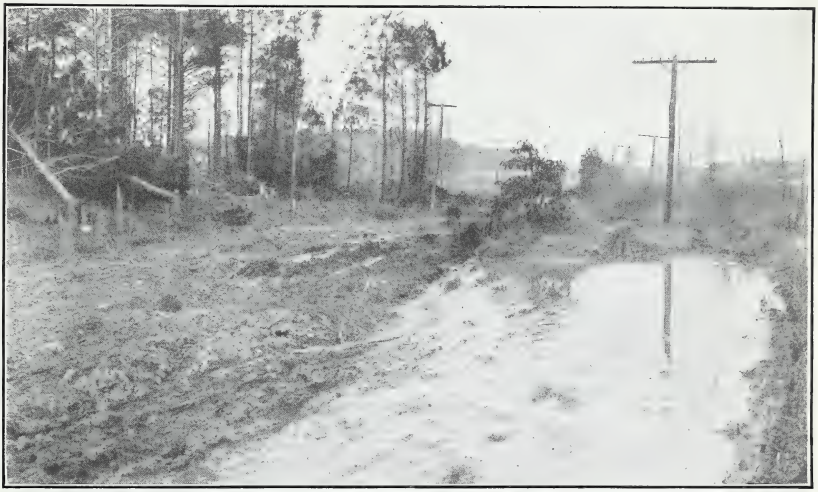
Cason
Colina
Reams
Dinwiddie C.H.
Butterworth
Meridian



OPRRE 3587

FIG. 1.—A POORLY DRAINED SECTION OF THE COX ROAD, MARCH, 1910, DINWIDDIE COUNTY, VA.

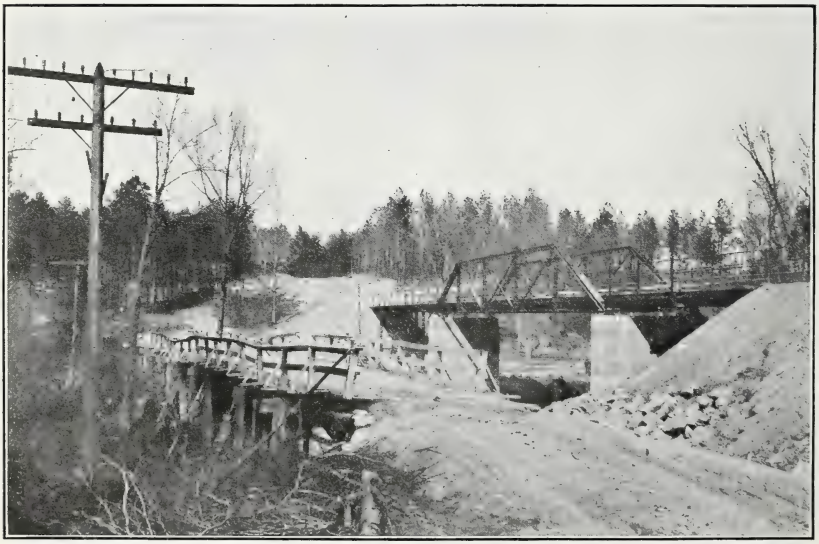
OPRRE 5011

FIG. 2.—COX ROAD, SAME LOCATION AS ABOVE, MARCH, 1911. TOP SOIL, DINWIDDIE COUNTY, VA.

OPRRE 4976

FIG. 1.—TRAFFIC ON BOYDTON PLANK ROAD, MARCH, 1911, DINWIDDIE COUNTY, VA.

Load, 2 tons on each wagon.



OPRRE 7482

FIG. 2.—TYPE OF NEW STEEL BRIDGE ON BOYDTON PLANK ROAD, MARCH, 1912, DINWIDDIE COUNTY, VA.

OPRRE 4992

FIG. 1.—CONSOLIDATED SCHOOLS, DINWIDDIE COURTHOUSE, DINWIDDIE COUNTY, VA.
Six rooms and auditorium. Cost $6,000. Built since roads were improved.

OPRRE 7314

FIG. 2.—SCHOOL WAGON WHICH CARRIES 20 CHILDREN FROM DEWITT TO DINWIDDIE COURTHOUSE, 6 MILES, MARCH, 1912, DINWIDDIE, VA.

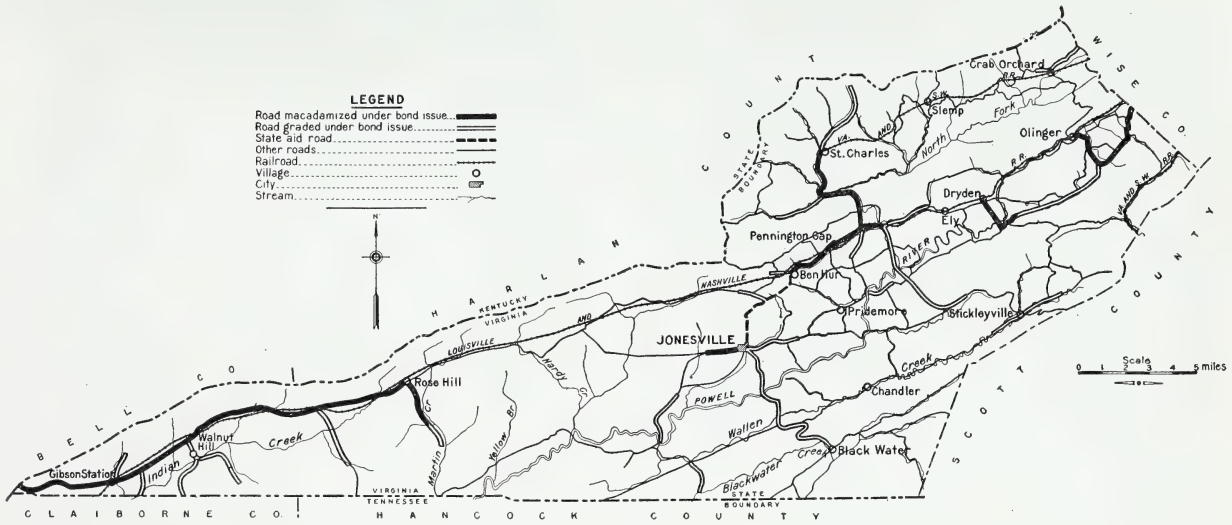
OPRRE 5165

FIG. 1.—ROAD NEAR OLINGER, MARCH, 1911, LEE COUNTY, VA.

OPRRE 9325

FIG. 2.—ROAD NEAR OLINGER, MARCH, 1912, LEE COUNTY, VA.

Macadam. New schoolhouse in distance on left.



F-3

MAP OF LEE COUNTY, VA., SHOWING IMPROVED ROADS, 1915.

OPRRE 11208

FIG. 1.—THE HUB-DEEP BLACKWATER ROAD IN MARCH, 1911, LEE COUNTY, VA.

OPRRE 9793

FIG. 2.—THE BLACKWATER ROAD IN MAY, 1913. GRADED EARTH, LEE COUNTY, VA.

OPRRE 4800

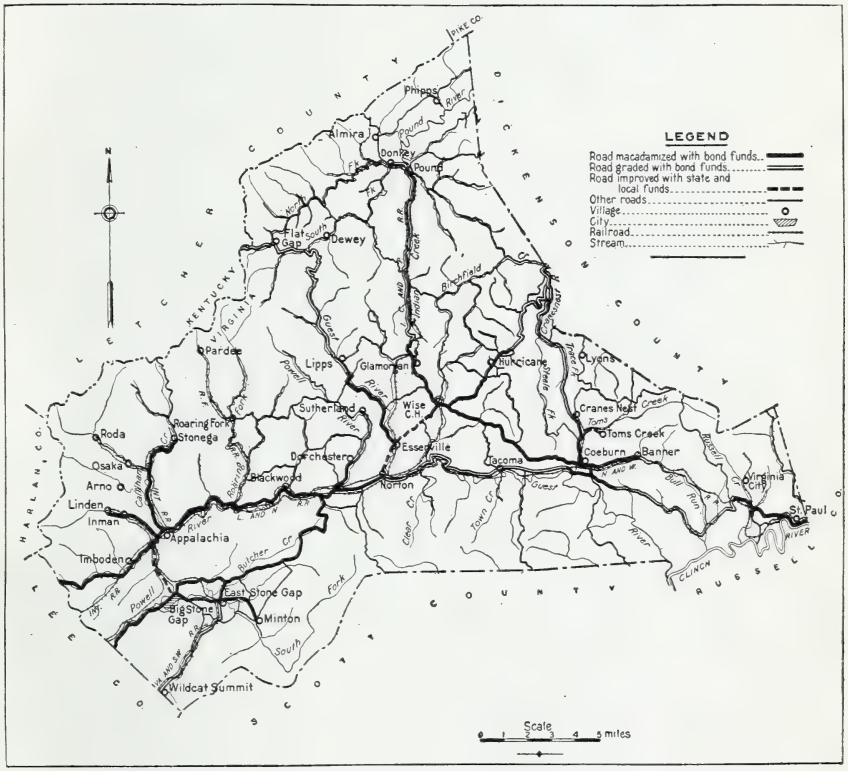
FIG. 1.—ROAD IN WHITE SHOALS DISTRICT, POWELLS VALLEY, LEE COUNTY, VA.
This county did not vote for a bond issue.

OPRRE 9812

FIG. 2.—MACADAM ROAD IN ROSE HILL DISTRICT, POWELLS VALLEY, LEE COUNTY, VA.

FIG. 1.—BIG STONE GAP TO LEE COUNTY LINE. OLD LOCATION, MARCH, 1911, WISE COUNTY, VA.

FIG. 2.—BIG STONE GAP TO LEE COUNTY LINE. NEW LOCATION, MAY, 1913, WISE COUNTY, VA.



MAP OF WISE COUNTY, VA., SHOWING IMPROVED ROADS, 1915.

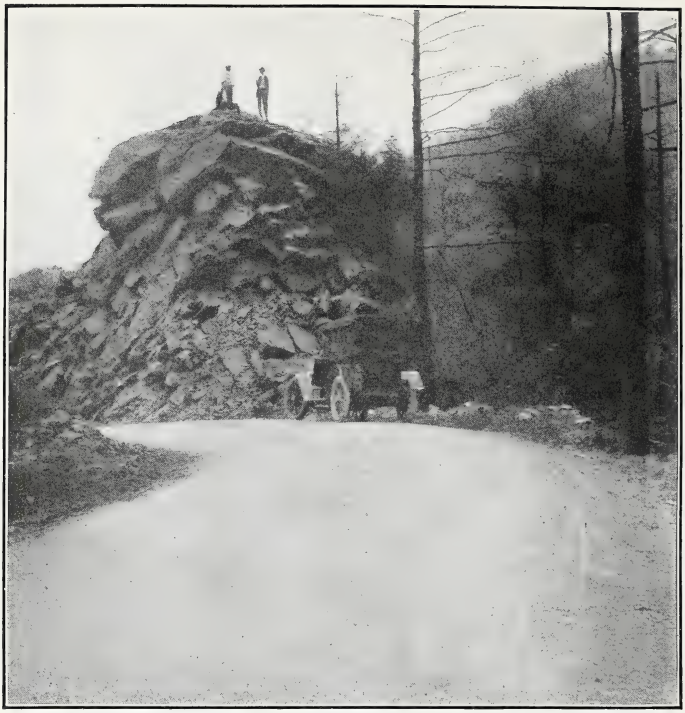


FIG. 1.—STATE-AID ROAD BETWEEN BIG STONE GAP AND APPALACHIA, WISE COUNTY, VA.

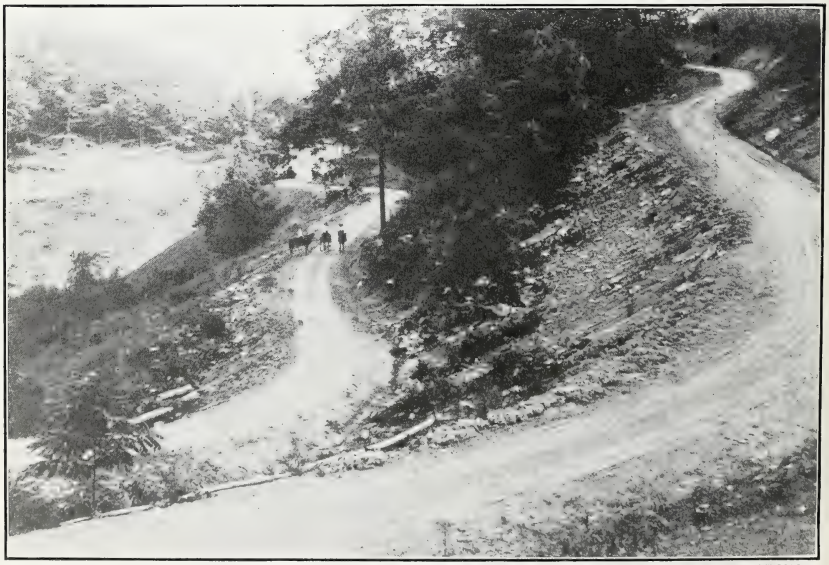
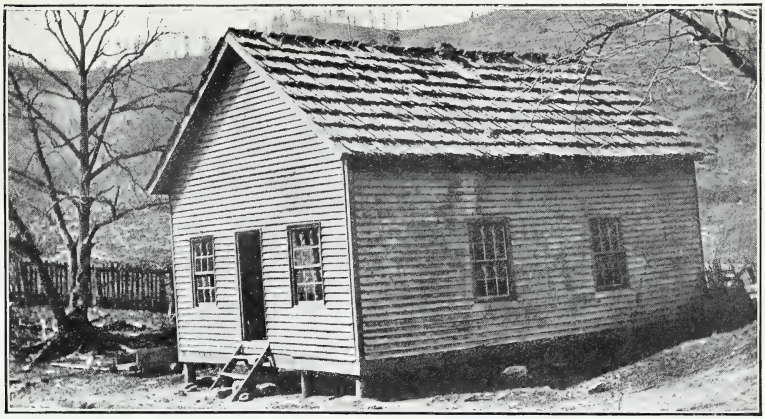


FIG. 2.—NEW ROAD BETWEEN WISE AND COEBURN, MAY, 1913, WISE COUNTY, VA.



OPRRE 14425

FIG. 1.—HURRICANE DISTRICT SCHOOL.

OPRRE 14423

FIG. 2.—POUND DISTRICT SCHOOL.

OPRRE 14424

FIG. 3.—THE HURRICANE AND POUND CONSOLIDATION INTO THE NEW HUTCHINSON GRADED SCHOOL, WISE COUNTY, VA.

OPRRE 9663

FIG. 1.—COUNTY ROAD, TOWN OF SANTA CLARA, IN THE ADIRONDACKS, MAY, 1913, FRANKLIN COUNTY, N. Y.

OPRRE 10998

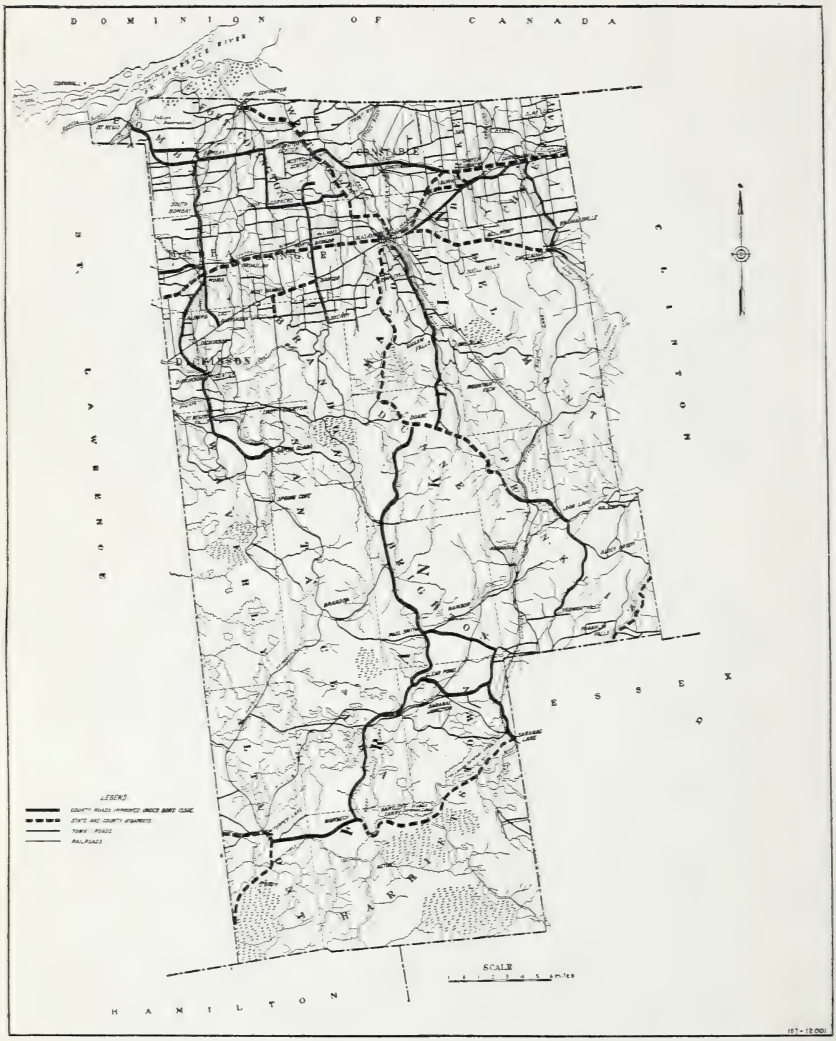
FIG. 2.—COUNTY ROAD, MACADAM, SAME LOCATION AS ABOVE, MAY, 1914, FRANKLIN COUNTY, N. Y.

OPRRE 7697

FIG. 1.—COUNTY ROAD, EARTH, TOWN OF BANGOR, MAY, 1912, FRANKLIN COUNTY, N. Y.

OPRRE 11015

FIG. 2.—COUNTY ROAD, MACADAM, SAME LOCATION AS ABOVE, MAY, 1913, FRANKLIN COUNTY, N. Y.



MAP OF FRANKLIN COUNTY, N. Y., SHOWING STATE AND COUNTY HIGHWAYS AND COUNTY ROADS.

OPRRE 7692

FIG. 1.—TRAFFIC ON COUNTY ROAD BEFORE IMPROVEMENT, FRANKLIN COUNTY, N. Y.
Average load 10 cans of milk, 1,020 pounds.

OPRRE 10993

FIG. 2.—TRAFFIC ON TOWN ROAD AFTER IMPROVEMENT, FRANKLIN COUNTY, N. Y.
Maximum net load for four horses, 6,300 pounds.

OPRRE 11014

FIG. 3.—AUTOMOBILE TRUCK TRAFFIC ON COUNTY ROAD AFTER IMPROVEMENT, FRANKLIN COUNTY, N. Y.
Maximum net load 50 cans of milk, 6,000 pounds.

OPRRE 11006

COUNTY PATROLMEN, FRANKLIN COUNTY, N. Y.

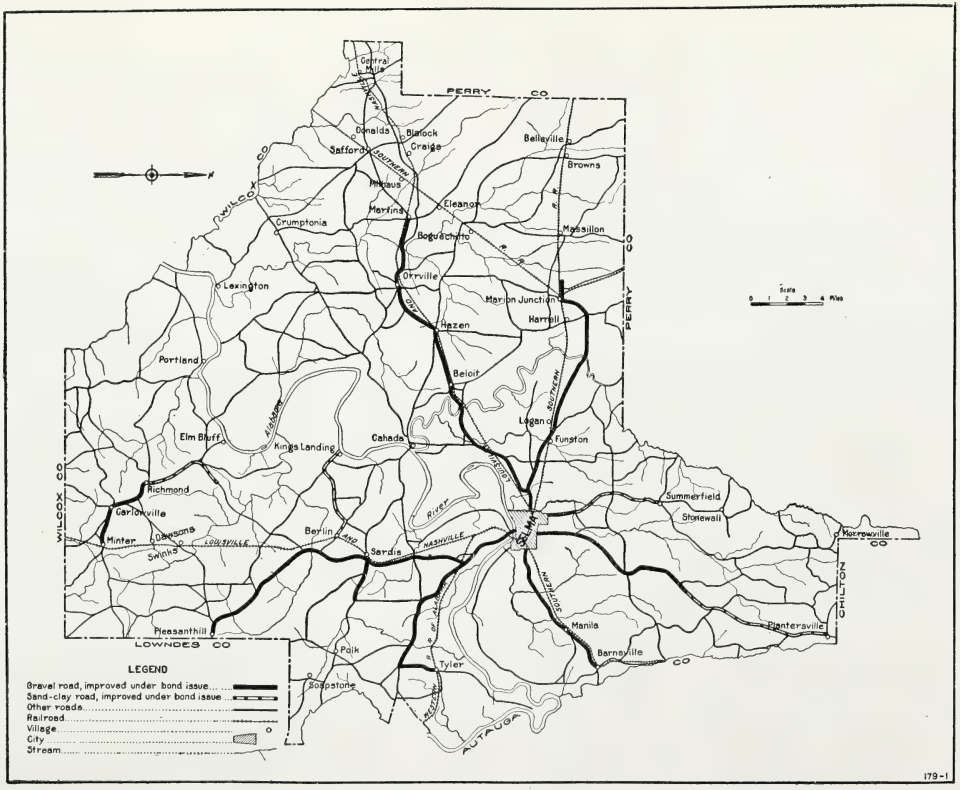
Each patrolman has from 2 to 8 miles of road, receives $3 per day, and is employed when needed.

OPRRE 10860

FIG. 1.—SUMMERFIELD ROAD, 8½ MILES FROM SELMA, DALLAS COUNTY, ALA.
General condition of entire road before improvement.

OPRRE 10887

FIG. 2.—SUMMERFIELD ROAD AFTER IMPROVEMENT WITH GRAVEL, DALLAS COUNTY, ALA.



MAP OF DALLAS COUNTY, ALA., SHOWING IMPROVED ROADS, 1915.

PLATE XXVI.

OPRRE 4912

FIG. 1.—BURNSVILLE ROAD, OLD LOCATION, DALLAS COUNTY, ALA.

OPRRE 9345

FIG. 2.—BURNSVILLE ROAD, NEW LOCATION, SURFACED WITH GRAVEL, DALLAS COUNTY, ALA.

OPRIE 8116

A New Industry on the Marion Junction Road, Dallas County, Ala.

OPRRE 7045

FIG. 1.—BONITA ROAD, FEBRUARY, 1912, LAUDERDALE COUNTY, MISS.

OPRRE 8751

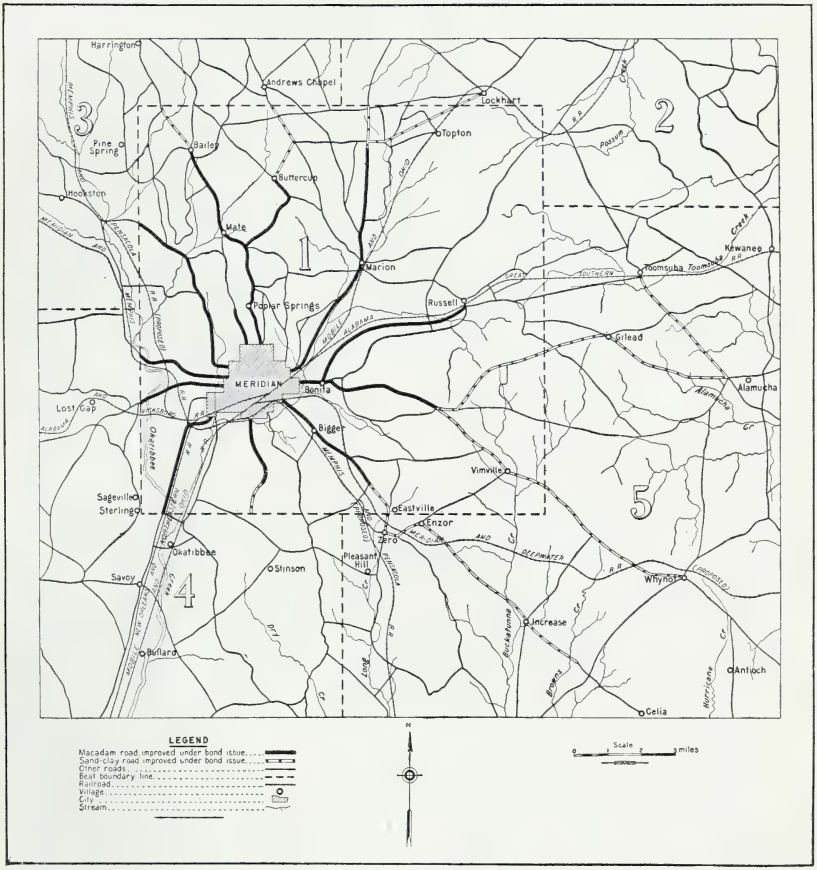
FIG. 2.—BONITA ROAD, MARCH, 1913, GRAVEL-MACADAM, LAUDERDALE COUNTY, MISS

OPRRE 7044

FIG. 1.—BONITA ROAD, FEBRUARY, 1912, LAUDERDALE COUNTY, MISS.

OPRRE 8752

FIG. 2.—BONITA ROAD, MARCH, 1913, GRAVEL-MACADAM, LAUDERDALE COUNTY, MISS.



MAP OF PART OF LAUDERDALE COUNTY, MISS., SHOWING IMPROVED ROADS, 1915.

OPRRE 7042

FIG. 1.—CAUSEYVILLE ROAD, FEBRUARY, 1912, LAUDERDALE COUNTY, MISS.

OPRRE 8736

FIG. 2.—CAUSEYVILLE ROAD. SAME LOCATION AS ABOVE, GRAVEL-MACADAM SURFACE, FEBRUARY, 1913, LAUDERDALE COUNTY, MISS.

OPRRE 7043

FIG. 1.—BONITA ROAD, FEBRUARY, 1912, LAUDERDALE COUNTY, MISS.

A merchant paid $25 per 100 pounds for 4-mile haul, or $1.25 per ton-mile, and postoffice authorities paid $12.50 per day per 1 day's mail delivery a few days before this photograph was taken.

OPRRE 8754

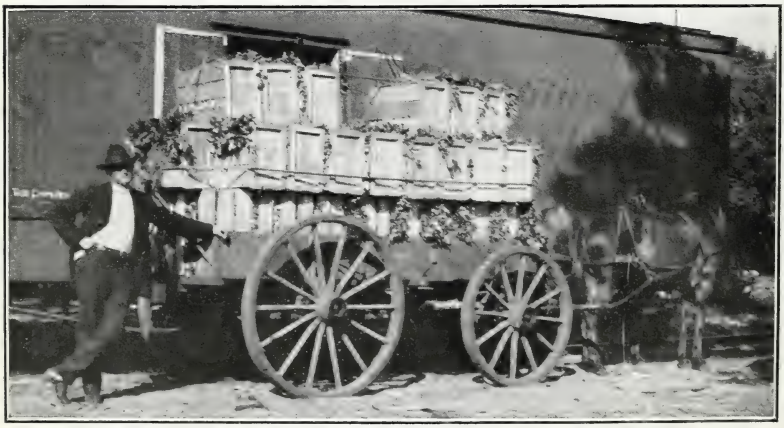
FIG. 2.—BONITA ROAD, GRAVEL-MACADAM. SAME LOCATION AS ABOVE, MARCH, 1913, LAUDERDALE COUNTY, MISS.

OPRRE 5120

FIG. 1.—MANATEE-SARASOTA ROAD, MANATEE COUNTY, FLA., IN 1911.

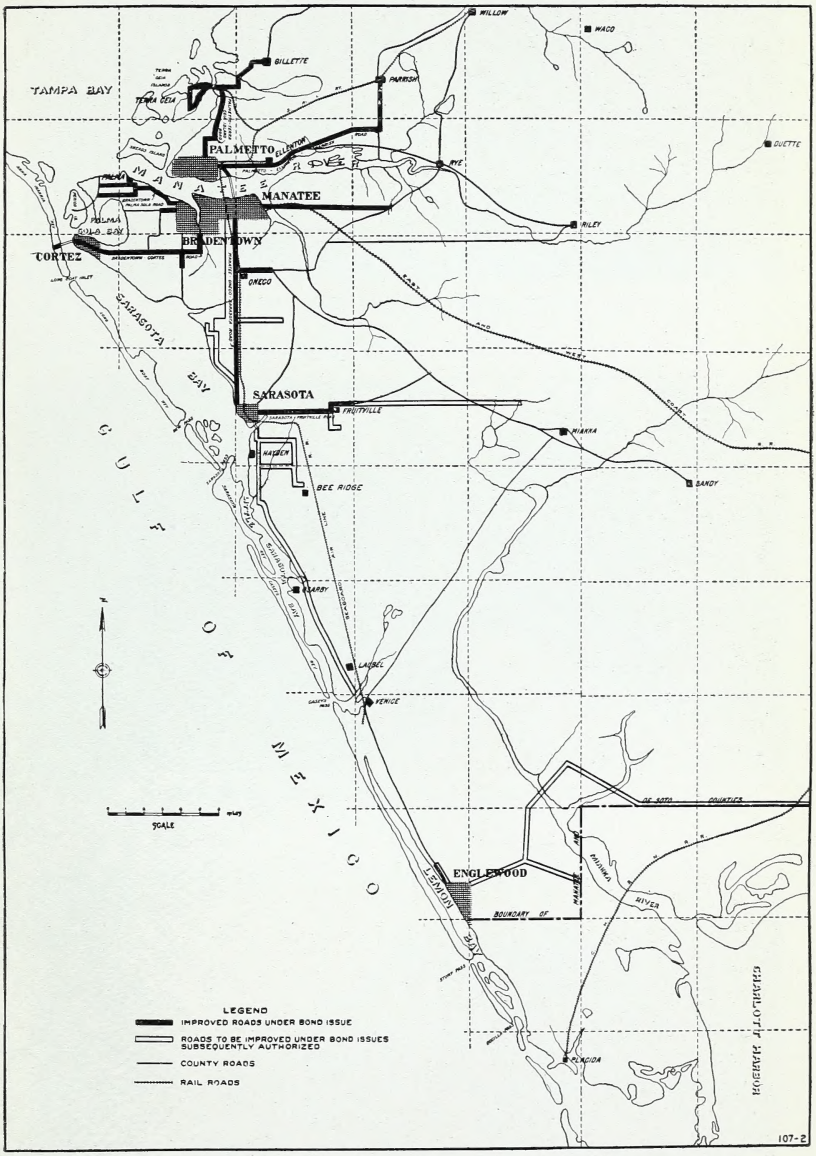
OPRRE 8415

FIG. 2.—MANATEE-SARASOTA ROAD IN 1912.



OPRRE 5119

FIG. 3.—TRAFFIC FROM MANATEE-SARASOTA ROAD. NET LOAD 45 CRATES OF CELERY, 3,600 POUNDS.



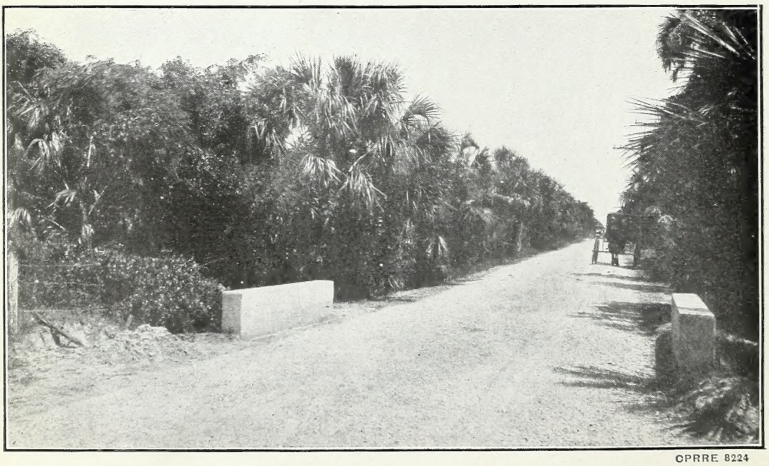
MAP SHOWING THE MARKET ROAD SYSTEM, MANATEE COUNTY, FLA.

OPRRE 5103

FIG. 1.—ELLETON-BELK ROAD, 1911.

OPRRE 8443

FIG. 2.—ELLETON-BELK ROAD, 1912. SHELLS.



OPRRE 8224

FIG. 3.—PALMETTO-TERRA CEIA ISLAND ROAD, 1912. MACADAM.

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